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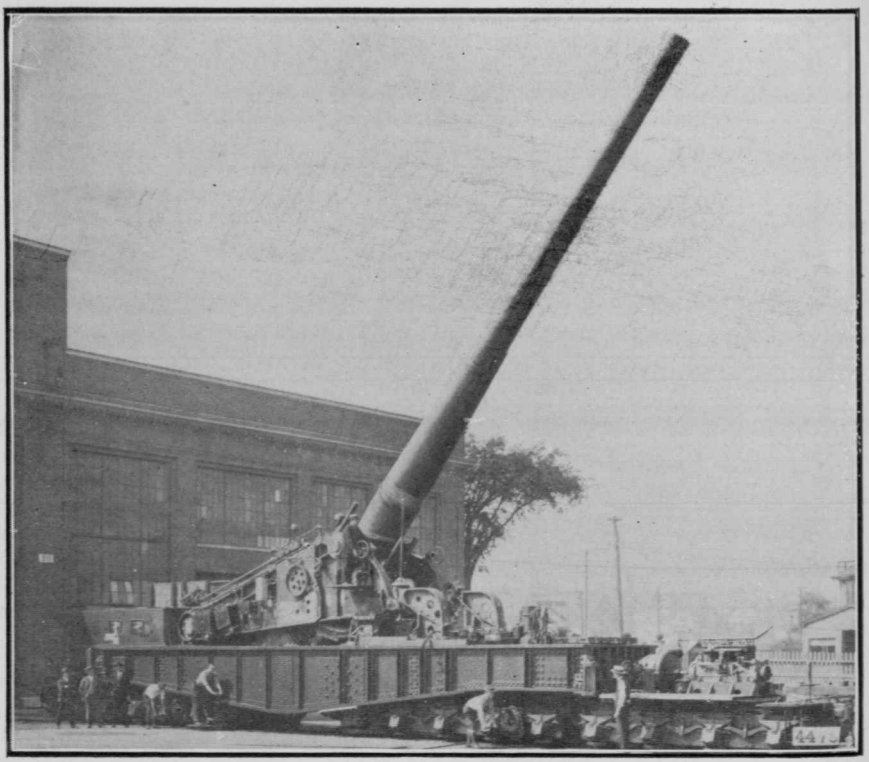


THE 14-INCH GUN, RAILWAY, MODEL 1920

The Coast Artillery Journal

Vol. 57 No. 5 NOVEMBER, 1922 Whole No. 195

The American Artillery in France

By Brigadier General A. Maitre, French Army

Translated by Colonel Frank E. Harris, I.G.D., from Revue d'Artillerie, January, 1920

The following pages are extracts from a lecture delivered in July 1919, by General Maitre of the Artillery, of the French Mission to the American Army. Their presentation now, on the occasion of the fourth anniversary of the termination of hostilities, is believed to be especially appropriate, when the lapse of years has already served to dim the memory of the great effort of the American Artillery.

No appraisal of the American Artillery in France could be more fair than that of General Maitre, who saw its development from the beginning, and who observed with a trained eye, and judged with an analytic yet sympathetic mind.

IT is difficult to conceive the formidable effort exerted by the American Army in a very short time without a detailed examination of what that effort represents.

At the beginning of 1917 the American Army comprised:

Regular army—6000 officers, 150,000 men.

National guard 6000 officers (11,900 in August, 1917,) 150,000 men.

These effectives were not organized into units above brigades or regiments.

At the time of the armistice the American effectives comprised in France:

Officers 100,000

Men 2,050,000

forming 41 divisions of which 29 were at the front.

These divisions were subdivided into two armies engaged on both sides of the Moselle. The 3rd army was only organized after the armistice for the occupation. It was formed of elements drawn from the 1st and 2nd armies.

Each army comprised three large army corps. These large units were organized with all the staffs and auxiliary services; however, the Army Artillery was not all American.

On the same date, November, 1918, there were also very considerable effectives in the United States, in the neighborhood of about 2,000,000 men, ready for transportation to France to bring the number of divisions up to 80 and to more than meet the losses which the French Army might suffer.

CHAPTER I

GENERAL CONSIDERATIONS

Before going further it would seem advisable to give a general idea of the organization of the American division.

Its composition was as follows:

Officers, 944, including 208 of the artillery
Infantry, 16,900 men, 4 regiments and 1 machine gun battalion
Artillery, 4,800 men, 3 regiments
Engineers, 1,600 men, 1 regiment
Signal Corps, 480 men, 1 battalion
Train 3,000 men about
Total 27,724

or more than 27,000 men, which were almost equivalent to two French divisions at the end of the war.

Thus the United States had raised in 18 months, from April, 1917 to October, 1918, an army of four million men, half of whom, or about two million, had already been transported to France.

To attain this formidable result they had at first grouped the units of the regular army into 6 divisions numbered from 1 to 6, and those of the National Guard into 17 divisions, numbered from 26 to 42.

The effectives of these divisions had in the beginning been filled by voluntary enlistments, then, starting with September, 1917, by draft; the latter also permitted the subsequent formation of 17 divisions of the National army, numbered 76 to 92.

Finally, beginning with 1918, the entire army became the National Army, the old divisions preserving their numbers; the new divisions were numbered to complete the series from 1 to 50 and from 76 to 104, thus providing for the first 80 divisions. It should be stated that the Americans were prepared to raise more in case of need, their draft system being capable of producing 10 million men.

It is quite difficult for us to estimate the effort corresponding to the formation of all parts of a considerable army, when it is a question of supplying it completely with clothing, equipment, arms, etc. We may, however, gain an approximate idea of it by recalling the efforts required to improve and complete our own equipment. Let us recall the inevitable delays in accomplishing each transformation: clothing, armament (57-mm. guns, etc.).

Transportation—The creation of this army was not the least of the difficulties of the United States; it had to transport them to France.

The transportation may be divided into two great periods:

1st, Up to June, 1918:

The winter of 1917-1918 was extraordinarily severe in the United States, disorganizing the land transportation to a certain extent, particularly in respect to supplying coal to the ports. At this time we were short of wheat and of certain provisions, and we had to choose between wheat and men.

Finally the United States could only avail themselves of their own ships.

As a consequence the first movements were relatively slow and the monthly average was only from 50,000 to 60,000 men.

In May, the American army in France comprised 425,000 men.

2nd. Starting with May, the situation changed as by enchantment.

We were supplied with wheat; the English placed a large number of ships at the disposal of the American Army and, during the great spring push of the Germans, the Americans landed in France in compact masses. The monthly average was about 270,000 men (310,000 in July and September).

This flow in mass was comforting to our command in the most trying moments of the war, for it saw its reserves replenished more rapidly than all possible losses. Moreover, the Americans demanded to go into action, regardless of their training (and this was at times rudimentary, which occasioned losses); the influence produced by the uninterrupted arrival of these contingents cannot be overestimated.

At the time of the armistice there were in Europe two million men and there would actually have been four million men had not the armistice stopped the movements of the transports.

It is interesting to note that despite the submarine warfare, this movement of two million men was made with a loss of but 300 men as a result of torpedoing, whilst influenza caused far more considerable losses.

CHAPTER II

ARTILLERY

After this general view of the American effort, let us glance over the American Artillery.

In France we designate under the name *Artillery* an arm and a service in one.

In the United States the situation is quite otherwise.

The artillery constitutes the combatant arm. All our artillery services are grouped in what the Americans call *Ordnance* (See Chapter III).

In addition, the Artillery comprises two absolutely distinct branches, whose officers, specialized on leaving the schools, are not even united for promotion. They are:

The Field Artillery;
The Coast Artillery.

On mobilization and for reasons difficult for us to understand, these two branches remain distinct.

Field Artillery

The Field Artillery of the regular army comprised in 1916:

Officers	250
Men	5,500
Regiments	6

It was in the course of being increased in 1917. The six regiments had become 21 on paper, the 250 officers had become 400, but the enlisted personnel really comprised only the numbers given above, and the Field Artillery had to form all the divisional and army corps artillery, besides helping out the national guard artillery and some cavalry regiments which it incorporated.

The large American division: 28,000 men, of which nearly 17,000 men were infantry, had to have as divisional artillery:

6 battalions of 75's divided into two regiments;
2 battalions of 155's forming a motorized regiment

or nearly 5,000 artillerymen. (In the beginning the regiments of 155's were organized with animal traction, but they were afterwards transformed as they arrived in France by providing 5 ton caterpillar tractors, which gave complete satisfaction.)

The corps artillery, completely motorized, was formed by the artillery brigade of the replacement divisions, which were not engaged as organized units in action.

It included:

1 regiment of 155's of 3 battalions of two batteries
1 regiment of 4.7 guns of 3 battalions of two batteries.

The very small effective of peace time had to become:

For 40 Infantry Divisions: 40 brigades, 120 regiments, 80,000 officers, 198,000 men.

For 80 Infantry Divisions: 80 brigades, 240 regiments, 16,000 officers, 396,000 men, not counting the necessary replacements.

In the nearly complete absence of officers of field rank corresponding to these formations, it was not surprising to have seen captains become generals of brigades in a few months.

Coast Artillery

The Coast Artillery comprised in 1916:

Officers	750
Men	20,000
Companies	170

It was in the course of being increased in 1917, but its enlisted personnel actually comprised but the numbers given above, and it had to furnish:

(a) The heavy railway artillery for the 1st Army, and afterwards for all the expeditionary corps, or:

3 brigades, 9 regiments, 540 officers, 16,200 men.

(b) The heavy artillery for the 1st and 2nd armies, the allowance established for each army being:

4 brigades of 3 regiments of 6-inch or 155-mm. guns, 72 battalions;
4 brigades of 3 regiments of 8-inch or 9.2-inch howitzers, 72 battalions;
5 regiments of motorized 75's.

175 battalions for one army

348 for the two armies.

all with mechanical traction.

It is observed that the heavy artillery was given as a whole to the armies, without reserves at the disposal of the superior commander, but the idea developed to reduce the permanent assignment to the armies and to form as with us, a general artillery reserve with the same mission as that given to our R. G. A.

The units to be created comprised, therefore,

18 brigades, 58 regiments, 4,500 officers, 105,000 men.

There was no provision of special heavy artillery for the 40 supplementary infantry divisions intended to replace the French infantry divisions for the campaign of 1919.

(c) The Trench Artillery.—This artillery comprised:

One divisional battery per division, armed at first with the 58-mm. then with the (150-mm) English Stokes, and finally our Fabry.

One battalion of 4 batteries of 240-mm. per army corps.

The units to be created included therefore:

40, then 80 divisional batteries, 400 officers, 13,000 men.

6, then 12 battalions, 420 officers, 8,400 men.

Total 820 officers, 21,400 men.

Here, too, there developed the idea of diminishing the permanent assignment to the large units and forming a division of R. G. A. with the trench artillery.

(d) The anti-aircraft batteries, comprising:
1 battalion of 4 auto-mount batteries per army corps;
4 semi-fixed sections per army corps.

That is, for
6 army corps, 6 battalions, 100 officers, 3,300 men
12 army corps, 12 battalions, 200 officers, 6,600 men.

To summarize, the small effective of the coast artillery had to become:

Heavy Railroad Artillery	540 officers	16,200 men
Heavy Artillery	4,500 officers	105,000 men
Trench Artillery	820 officers	21,400 men
Anti-Aircraft Artillery	200 officers	6,600 men
or a total of	6,060 officers	149,200 men

without counting the necessary replacements.

TRAINING

Beginning in July, 1917, General Pershing issued orders to train and and form the American artillery after the French method.

Given the weak resources of peace time, namely:
1,000 regular officers of Field and Coast Artillery.
25,000 regular soldiers of Field and Coast Artillery.

It was necessary to take up the creation of a considerable number of officers and the complete training of the units formed.

(a) Officers

In spite of its magnitude, the problem was comparatively easy in respect to the junior officers in view of the resources furnished by the educated youth of the United States.

In August 1917, General Pershing decided to utilize the French schools (Fountainebleu, Mailly, Bourges, Vincennes, Arnonville) to train the officers of the first units and to develop instructors for the American schools which were created at Saumur, Houssimont (later Angers,) Vincennes (afterwards Gien).

In August 1918, the schools had trained:

Fountainebleu and Saumur	4,900 officers
Houssimont and Angers	4,100 officers
Vincennes (automobile driving)	1,000 officers

(drawn from the two categories above)

In addition, the great training centers and camps which will be mentioned below, permitted a completion of the training of a part of the officers coming from these schools and of those arriving from the United States, by adding the practical instruction to the theoretical training already received.

By the end of October 1918, nearly 12,000 officers had passed into the camps and centers.

The question was far more difficult for the field officers. These officers had participated in the training of their units in the great camps or centers, but it had not been possible for different reasons, to organize a center of studies similar to our own center at Vitry. The American Center of Artillery Studies, modeled on our own, had not begun to function at Langres or at Treves until after the armistice, (4 courses in all) and was greatly appreciated by all the general officers and field officers who were sent there.

(*b*) *Troops*

The training of the troops had been organized in accordance with the following general program:

I Technical instruction, after the French methods, in a huge field or camp which permitted the execution of varied and extensive firings.

II Probation period of the brigade on the front.

III Combined maneuvers of the artillery brigade with the complete division.

For the purpose of this instruction the following camps for Field Artillery were organized:

Valdahon	1 brigade	
Coetquidan	2 brigades, later 3	
Meucon	2 brigades, later 3	
Souge	2 brigades, later 3	
La Courtine	1 brigade	
Le Courneau	1 brigade	
	9	12

As a consequence of the arrival in mass at the beginning of the summer of 1918 (8 brigades in June, 9 in July), waiting zones had to be organized near the great camps; by the end of July there were more than 20 brigades under training (60 regiments).

For the formation and training of the heavy tractor artillery, there were utilized the French automobile drivers' schools of Tremblay, Dourdan, Boulogne, Sathonay, and they created the centers of:

Mailly	Heavy railroad artillery
Libourne	3 regiments, later 4
Limoges	3 regiments
Clermont	3 regiments
Angers	3 regiments
Angouleme	3 regiments

In November 1918 we had received in France:

33 brigades of divisional artillery	99 regiments
6 brigades of corps artillery	18 regiments
3 brigades of Heavy railway artillery	9 regiments
8 brigades of heavy tractor artillery	24 regiments
Total	150 regiments.

EQUIPMENT

The equipment of these units was more difficult than their training.

Artillery matériel.—The French government was to furnish the 75's, 155 C. S. 155 L.G.P.F. and the greater part of the horses; the English undertook the supply of the 8-inch and 9.2-inch howitzers.

Many officers have asked why the Americans did not furnish their own matériel. It should be remembered that in France we have never been able to put a new matériel into service sooner than 18 months and sometimes longer, and yet we had at out disposal constructors who knew their business and skilled mechanics of the highest class.

The Americans have a formidable industry, but they produce especially large forgings with an accuracy insufficient for artillery matériel; furthermore, they had only received the plans and drawings of our pieces in September 1917. Under these conditions it was absolutely impossible for them to obtain this matériel before January 1919.

Indeed a small number of guns constructed in the United States were beginning to appear at the time of the armistice, and in 1919 we would have had as much matériel as was necessary to equip the American army and even to furnish replacements for the French Army.

Thus, then, we had to arm the American batteries, and this at a time (Spring and Summer of 1918) when the battle was using up a great quantity of matériel in our armies; there were difficult moments, but the result was obtained by ceasing the creation of new French units.

Horses.—The same difficulties arose as to horses, for our resources were exhausted and the motorization of certain of our units did not proceed as quickly as anticipated, owing to the wear and tear at the front.

The difficulty of obtaining horses forced the Americans to motorize all their army artillery, the corps artillery, and even the regiment of 155 C. S. divisional artillery, the training personnel of the regiment being trained in a great school at Le Blanc.

The objection which arose in the minds of a great many French officers was this:

"Why did not the Americans bring horses from the United States? Why did they not bring autos and tractors in greater quantities?" The answer is quite simple: they obeyed the high allied command who demanded ***infantry*** before everything, in order to feed the battle without further thought.

Under these conditions the Americans had sent infantry in great numbers, 200,000 to 300,000 per month, at times rendering the organization of their large units difficult by reason of a lack of matériel.

They should not be criticized since they sacrificed personal considerations in order fully to satisfy the high allied command.

Results.—At the time of the armistice, the results attained were as follows;

Artillery Effectives trained in France, from American reports.

	Officers	Men	Total
Divisional Field Artillery	7,978	205,213	213,191
Heavy Artillery Centers and Schools	4,010	77,994	82,004
Trench Artillery Center	459	8,400	8,859
Saumur School	1,548	3,393	4,941
Anti-Aircraft Artillery Center	184	4,645	4,829
Replacement Regiments of Field Artillery	432	28,273	28,705
Replacement Battalions of Heavy Artillery	218	10,804	11,022
	14,829	338,722	353,551

And we had:

In action:

3 brigades, 9 regiments Heavy railway artillery
25 brigades, 75 regiments divisional artillery
9 Brigades, 9 regiments heavy tractor artillery

93 regiments.

Also in training:

8 brigades, 24 regiments divisional artillery
11 brigades, 33 regiments heavy tractor (army or corps)

57 regiments.

These figures are significant when we consider what the American artillery was in 1917.

ORGANIZATION OF THE COMMAND

It approached the French organization.

At G.H.Q.—

A chief of artillery particularly charged with the organization and training of the units before their entry into the line, who was able to advise the General in Chief on all matters relating to the artillery, training, organization, employment, etc.

In each army.—Attached to the General of the Army, a General commanding the Army Artillery with functions quite analogous to those of the Generals commanding the Army Artillery in France, and exercising in addition the command of all the Army Artillery. The command

of this mass of artillery distributed between the front and rear, was not any easy thing.

The Army Artillery, too, had staffs of a strength of which we had no idea (up to 120 officers). The ideas continued to develop and it seems that the organization had become absolutely like that of our R. G. A.; the advanced zone of organization prepared at Doulevant was to have become the headquarters of the division of R. G. A. of tractor artillery, as also the zone of Vitrey was to have become the headquarters of the division of Trench Artillery, Houssimont remaining for the heavy railway artillery.

In each army corps.—A General commanding the artillery of the army corps. The organization of this command had been very delicate. For a long time it has been desired that the same General should command the artillery of the army corps, and the brigade of corps artillery, which was opposed to the rôle of coordination incumbent on the artillery command of the corps artillery. In the end, the command was organized as in the French army corps.

In each Division.—A General commanding the divisional artillery with the same functions as our Colonel commanding the divisional artillery.

ACTUAL TENDENCIES

The American artillery was actually directed towards the complete motorization of the artillery.

This tendency arose from: The difficulty of obtaining horses and of their maintenance during the fighting;

The industrial character of America;

Its wealth in gasoline;

The great distances to be covered in case of military operations in America.

The principle which governed the motorization was that of *standardization.* The Americans, like ourselves, had suffered from the diversity of models, which rendered the supply of spare parts very difficult; then, too, they wished to reduce the number of models to be employed in the future to a minimum.

The question is still under study and numerous boards have been appointed to consider the question.

Up to the present the prevailing ideas would seem to be the following:

Artillery Matériel

Divisional artillery	75's and light howitzers (120 mm. or failing these 155 C. S.)
Corps artillery	155 C.S. howitzers, 4.7 guns (120 mm.) and 155 L. G. P. F.

Army artillery — 75mm. guns, 55 L., 194, 220, 240; 155 C. S. howitzers, 8-inch or 220 mm. 9.2-inch or 280 mm.

Heavy railway artillery: Which cannot be replaced by ordinary tractors: 220, 240, etc.

Tractors

Mechanical traction will be employed for all artillery of corps and army artillery.

In addition, the regiment of 155 C. S. of the division is already motorized and they provided for motorizing the regiments of 75's of the division, at first, one regiment and afterwards both.

The Americans employed caterpillar tractors for this purpose:

2.5 ton — for hauling the 75's. With a view to facilitating the standardization, many officers were already demanding the replacement of this tractor by the following.

5 ton — This tractor which gave entire satisfaction in the various regiments of 155 C.S. equipped with them will probably also be utilized for the 75's; they were to have a considerable number of these tractors, which would have facilitated the carrying out of the exchange.

10 ton — These tractors were still few in number and besides developed defects in manufacture. Moreover they were somewhat light for the G. P. F.

15 to 20 ton — Few in number. They were Holt's, of the commercial type not adapted to military needs.

In addition, the Americans provided for the creation of an artillery mounted on caterpillars, according to the principles adapted in France for the St. Chamond matériel.

The question is under study. What we must bear in mind is the use of the 5 ton or similar and improved tractor, but not heavier, for hauling a conisderable number of artillery matériel of 75 mm. and 155 C.S.

This relatively light tractor gave a perfect tactical mobility, and we were able to see 155 C pieces, dragged by this tractor, pass over marshy terrain when our horses and four wheel drive tractors would have been engulfed.

Moreover, this light tractor, weighing 5 tons, permitted strategic mobility, as it could readily be loaded on our trucks for transportation over roads to great distances.

Trucks

The idea of standardization was also to govern in the organization of all other means of transportation.

It seems that they will adopt:

A four-wheel drive type truck for divisional artillery;

A two-wheel drive truck for the formations of the rear and long distance transportation over roads;

A 1 ton chassis on which will be mounted indiscriminately reconnaissance carriages, various ordnance cars, ambulances, etc.;

A light chassis of the Dodge or Ford type for replacing the motorcycle.

CONCLUSIONS

To sum up, the experience of the American artillery justifies the statement that it is possible to form and instruct the junior officers and the artillery units of all models in a very short time, two or three months at the maximum, provided there are available well organized firing ranges which permit of firing a large number of batteries every day, with about 15,000 shots as a total for each regiment of 75's, and 12,000 for each regiment of 155's.

The training of the field officers is more delicate and necessitates the organization and functioning of a study center intended to develop not only field officers of artillery but also the generals of all arms in all that which concerns the use of artillery. Lacking such a center, the results obtained by the good technical development of the men and of the junior officers, the risk is run that the latter will not be utilized to their best advantage in action.

CHAPTER III

ORDNANCE

The Ordnance Department is charged with the procurement and distribution of the matériel necessary for the artillery (matériel, armament, harness,) as well as tanks, tractors, special automobiles, machine guns, small arms, infantry equipment, ammunition; it must also maintain this matériel; in a word, it is charged with our Services of the Artillery.

At the beginning of 1917, the Ordnance Department of the American army comprised 85 specialized officers, derived from all branches, but more especially from the artillery, and a few hundred men.

At the time of the armistice, there were in France:

1803 officers

20,339 men.

It is comprehensible that all this personnel was not perfectly trained from the very first day, and it is easy to understand the difficulties that had to be surmounted.

ORGANIZATION OF THE ORDNANCE SERVICE

The ordnance service is placed under the orders of the (General) Chief of Ordnance; he was assigned to the General Headquarters of the

S. O. S. (Service of Supply, at Tours), with a representative at G. H. Q., A.E.F. (Chaumont).

S. O. S.

In the S. O. S. the service is divided into several branches:

Supply.—It is charged with the duty of receiving, storing and distributing supplies.

This branch operated at:

Bases	Montoir, Saint'-Sulpice, Miramas, for general supplies. Usine Brulée (Saint-Nazaire), Saint-Loubes (Bordeaux) etc., for ammunition.
Intermediate Zones	Gievres, Mehun, for general supplies. Issoudun for ammunition.
Zones of the Advance	Is-sur-Tille for general supplies. Jonchery (Villers-le-Sec) for ammunition.

Each of these organizations being considerable.

Further from them were the army depots, different according to the degree of engagement of the armies.

Construction and Maintenance.—This branch prepared the specifications and plans for the installation of the depots; it operated the large repair shops of Mehun and the other shops of the intermediate and advanced zones; it had particularly large installations at Romorantin, Courbevoie, Is-sur-Tille, Doulaincourt, Haussimont, etc.

Engineering.—This branch maintained a close liaison with the French and English. It had drafting offices at Tours, Paris, etc., proving grounds at Bourges, Mehun, Gavre and Quiberon.

Its mission was to furnish all the technical information to the other ordnance sections.

Training.—This branch was charged with organizing and maintaining the schools for forming the Ordnance personnel and training the artillery units in the maintenance of the matériel.

It had schools in all the artillery training centers and special schools at:

Is-sur-Tille (personnel of the repair section);
Jonchery (ammunition);
Bourges (ammunition and specialists);
Saint-John-des-Monts (machine-guns, etc.).

Purchasing.—An important branch charged with handling purchases in France and England.

The principal office was at Paris, with a branch in London.

This organization of the Ordnance in France took the place of all our services of the rear and the interior, ministry of armament, 3rd direction, establishments, general reserve depots, etc.

In the armies the ordnance service was organized as follows:

Army

In each army a Chief of Ordnance of the army was attached to the army staff, charged with the duty of assuring the service of supply, repairs, maintenance and inspection of all the ordnance matériel in the army.

This Chief Army Ordnance Officer had as assistant chiefs of sections with appropriate personnel:

(a) Ammunition officer (depot)
(b) Supply officer
(c) Artillery armament officer
(d) Small-arms officer
(e) Aviation armament officer
(f) Inspector of ammunition.

He was responsible for the functioning of the whole ordnance service of the army and assured the coordination of the different branches of his service, which were responsible to him, by making or prescribing all the inspections which he deemed necessary. The regulations and instructions insisted particularly upon the liaison of this chief with the army staff, without mentioning particularly the liaison with the artillery, which was, however one of its principal clients, if not the principal one.

(a) The ammunition depot officer was responsible for the direction and administration of the artillery depots and stockages.

(b) The supply officer was responsible for all questions of supply of ordnance material outside of ammunition.

(c) The artillery armament officer was responsible for the inspection, repair and maintenance of the artillery matériel including ordnance trucks and tractors. It was to he who was more especially charged with the relations with the army artillery command. He corresponded with our matériel inspector.

(d) The small-arms officer was responsible for the inspection, repair and maintenance of the small arms, the automatic arms and their ammunition.

(e) The aviation armament officer was responsible for all the armament issued to the aviation service.

(f) The inspector of ammunition was responsible for the maintenance of the ammunition (excepting small-arms); he was also the technical instructor of the troops in all that concerned ammunition. He corresponded to our ammunition inspectors.

This powerful organization existed in each army; it was attached to the army staff, 4th section and not to the artillery as with us.

Army Corps

In each army corps a Chief Ordnance Officer was attached to the staff of the Army Corps, who was responsible to the Commanding Gen-

eral of the army corps for the ordnance service (supply, repairs, maintenance among the troops) except in matters relating to ammunition.

He made such inspections as he deemed necessary; he supervised the repair sections of the army corps and was authorized to communicate directly with the army Chief of Ordnance on all technical questions.

Division

In each division the Division Ordnance Officer, on the staff of the divison is responsible to the division commander for the proper functioning of the ordnance service (supply, repair, maintenance), except that relating to ammunition.

He makes such inspections as he deems necessary and supervises the repair sections of the division. He is authorized to correspond directly with his chiefs of ordnance on all technical matters.

Mobile Repair Section

The officer commanding the Mobile Repair Section of the division is under the direction of the division ordnance officer and is responsible to the latter for the maintenance and repairs which pertain to that mobile section.

Each division possesses a mobile repair section, well stocked with tools (3 officers and 45 men), charged with the repair and maintenance of the matériel of the artillery brigade, the trench artillery, the accompanying guns, the small arms and the equipment.

Each heavy artillery brigade has a special crew divided into two sections;

One section charged with the maintenance of the artillery matériel.

Each motorized regiment has a small crew charged with the maintenance of the artillery and automobile matériel.

In addition, each army corps and army have shops attached to the parks charged with the repair of the matériel not specially assigned to the repair units above or which cannot be repaired by them.

The matériel which could not be repaired by the formations of the front was sent to the large shops of Is-sur-Tille and Mehun.

All the personnel (officers and men) which served in these repair and maintenance units were ordnance personnel.

Repair Shops of Mehun-sur-Yèvre

The idea was to create a complete ordnance establishment capable of constituting a "base depot" sufficient to assure the maintenance and repair (excepting the repairs made at the front) of all the ordnance matériel utilized for an army of 2 million combatants.

For this purpose, the factory established at Mehun-sur-Yèvre which cost in the neighborhood of 125 million francs, was capable of:

Retubing more than 1000 guns per month;

Repairng per month 2000 matériel items (carriages, caissons, etc.), 150,000 rifles, 200,000 machine guns, and 5,000 pistols;
Casting 5 tons of steel and 1½ tons of brass per day;
Repair 100 tractors or trucks per day;
Store a large quantity of spare parts.

For the latter purpose there had been constructed 8 large storehouses and 12 large shops 75-m×150-m, with a modern tool installation extending from large lathes to machine tools of the greatest precision, all operated by electricity.

This factory was to employ about 100 officers and 5 to 6 thousand specialists. The installation was newly completed at the armistice and they were beginning to work.

This factory was afterwards employed to pack and reship the artillery matériel to the U. S. In the part reserved for small arms, they had dismantled, cleaned and assembled large quantities of rifles and machine guns picked up on the battlefield, before sending them back.

Another shop had furnished a great force, to readjust, clean and pack all the aiming and optical instruments.

Ammunition Supply

All the operating personnel in the depots belonged to the Ordnance; the artillery participated only through its ammunition sections, which constituted its transportation elements and on this subject, too, there were very lively discussions.

The transport service, M. T. C., wished to incorporate the artillery ammunition sections, which were all automobile, under the plea of putting all means of automobile transportation under a common head, but it appears that this solution was renounced for the time being. The discussion has not yet ended, but it might be well for the American artillery, already divorced from the Ordnance, to retain its means of transportation suitable for ordinary supply, calling for aid from the M. T. C. for exceptional supply, or temporarily lending its trucks for general transportation when the ammunition consumption is very slight, as we do in our armies.

Conclusions

The American army in 1917 comprised:
Regular army 6,000 officers 150,000 men
National guard 6,000 officers 150,000 men.
At the time of the armistice the Americans had in France:
100,000 officers, 2,050,000 men.

This large number of troops, new and full of ardor, had behind them a very complete organization in the zones of the base and in the intermediate zone. Their strength would now have been 4 million men had the armistice not stopped the transports.

After scorning it, after having declared that it could never be brought to a working basis the German command was finally brought to understand that the American army was not a myth but a reality; and what was still more serious, the soldier and the rear had both felt that it had arrived.

From that moment, the ardor of our troops at the front was doubled by the moral effect of this young army and the Germans were beaten, not as they have tried to say, by hunger, but very truly by the force of arms.

If our marvellous French army has permitted, by its courage and devotion, first the English, then the Americans to prepare themselves for the struggle, we must not stint our admiration for the latter who, starting from nothing, have reached the material results which we have just seen and who, by their effort placed in the service of the great cause, have contributed to bring about the complete defeat of the enemy army.

On the Firing Line of the Industrial Sector

II

By Jarratt A. Morford

Editor's Note: This is the second of a series of three articles by Mr. Morford, pointing out the Veteran's attitude towards the recruit.

ONE of the most difficult things to bring about in the consideration of a new environment or change of profession or occupation, is the fair and reasonable attitude toward men and things that will surround us in the, perhaps, unfamiliar undertaking. It is quite a natural and an intensely human trait, to set up as standard the training and experience of earlier connections and to appraise the physical environment by that which we have left and which should be behind us. Failure to subordinate earlier experience often plays havoc with our understanding of new problems because of our inability to measure fairly the true values. In short our mental attitude must be right if we are to start right, and failure to keep our mental attitude in balance means that our judgment can not but be befogged and the very least of our difficulties will be a decidedly unhappy experience. Much to our astonishment it may develop that despite a technical foundation which should carry us well, we find it is quite beyond our power to meet our new problems with any degree of understanding or success.

If this attitude is met with far too frequently in the recruit to industry, it also is met with constantly in the man within the industrial ranks towards those who seek to become a part of the industrial army, and for this reason it should be constantly borne in mind that the industrial veteran is setting his standards and his mental attitudes by the field which is his, which he knows and in which he has made his success. He is quite willing, in fact is quick to accept that which is of value according to his standards and which by his knowledge and experience in his chosen corner of the industrial line, he knows can be used to real advantage in the promotion of the manufacture or sale of his product; but he is equally reluctant—and rightly so—to hastily accept methods or precepts that are abstract to the business at hand, regardless of their successful application in fields of activity that are remote from his own. This fact is so generally found to be a stumbling block with the new recruit to industry, that it is rather a bug-bear with the average industrial chief who sometimes finds it necessary to use extreme measures to eradicate or lessen its unfortunate influence on his organization.

What would become of the control of those who listened to the textile superintendent, newly recruited to the artillery branch of the service, who in his long experience in textiles, found that a particular fabric dyed in an especially advantageous maroon dye would stand up very favorably in trying weather, but in the urging of its value and use, failed utterly to realize that while as a mill superintendent his advice and experience were of vital importance in such things, such matters were now in the hands of those apart from himself and that his post of corporal in an artillery company required other duties than that of determining uniform fabrics or colors, that while suggestions might be acceptable from him, in view of his background, his *job* was that of corporal and until such time as he was assigned to such special duty as expert fabric adviser, he could not, on the strength of his industrial prowess, waive all army discipline and duties. So it is that the lines are drawn on the industrial side and the veteran views with much disapproval the industrial production unit who with only his past experience as a warrant, attempts to hurdle into assignments aside from his own and who may feel that it is his privilege to do so because of his superior training.

The industrial army has not the finely drawn distinctions of rank of the fighting army, yet this in itself is a decided advantage for the recruit if he will understand the psychology of the men about him and realize that the seeming laxity in line demarcation is in reality much more jealousy guarded than are the perfectly drawn lines of rank in the fighting army. These lines, classed more by occupation than otherwise, run from the top to the bottom of industry, and are accepted, respected and observed by every unit.

The fighting army has opportunity in times of peace for very broad, comprehensive development of its units, so that a perfect understanding may be reached of things military without the hectic, feverish haste of urgent necessity, whereas the industrial army is constantly in action, ever under fire, and its personnel always on edge, little time being given to the study of relative rank and the fine lines of demarcation. The recruit is accepted and sent into its fighting ranks at once to learn as best he may, and is looked upon with that degree of respect and friendship which his understanding of the, sometimes, very intangible rights of his fellows seems to indicate in his attitude toward them. In the understanding of these rights, no task is more difficult than meeting and appreciating the immediate boss, of limited mentality and education, who has by sheer force of a pugnacious character made for himself a place of more or less restricted responsibility. He may be tyranical to the last degree, efficient in his limited sphere, with little possibility of further advancement, yet supremely satisfied with himself and his work. As a result he selfishly maintains his place, his knowledge and

his prestige, viewing with the utmost contempt any one who presumes to suggest methods that are in the least at variance with his own.

The writer once knew a young lieutenant of infantry who, with all the enthusiasm of his brilliant mind, came into a large industrial plant as a member of the supervising production end, to work up through, learning the production methods and later the general manufacturing end. He was so full of belief in himself, so sure of his making good that it seemed quite impossible for him to be other than a real success. In addition to his other fine qualities, he had a very analytical mind and was constantly determining the why-for's of obscure parts of his assignment, with the result that he had some quite worthwhile suggestions to offer his chief before long. But he had failed absolutely to appraise his chief correctly; he happened to be just such a man as the writer has sketched above. Finally, in desperation, the recruit told this petty tyrant his belief that the organization had made a colossal error in ever employing him to work under such a stupid, selfish incompetent (which was the truth in a great measure) and that he fully intended to take up the whole matter with those who could appreciate and understand. The lieutenant was not discharged, he was sent back to his work and told to "forget it." Right there he failed in his knowledge of his own position and of the fundamental basis of the character of his petty chief. He was really liked by the tyrant, who also put a lot of faith in the young man's ability which he realized was greater than his own, but despite his favorable opinion, the threat of the lieutenant and the deep hurt to the selfish pride of the chief prompted a disciplining which broke the lieutenant's spirit, nullified his work and finally prompted a question by the management as to his value and, through the recommendation of the production superintendent, he was discharged.

The whole affair hinged on the failure of the lieutenant to understand that the way to overcome the petty chief was to tactfully acknowledge his place and then work through him to advancement. Thus, despite the fact that there was no comparison between the two men as to mental qualifications or preparation, and that the lieutenant was admitted to be the finer man in every respect, he could not stand the test—for it was a test—and in that fact he caused the failure of all his hopes and ambitions so far as that particular plant was concerned. While the disaster of that undertaking will not, perhaps, follow him always, it is apt, in a measure at least, to influence some of those who may want his training but fear to buy and risk the lack of balance which would surely be indicated in the results of his tryout in his first plant and which certainly would not be modified by such extenuating circumstances as could be proven by himself or offered by his references.

Frequently a sharp division is made in the reward for good work as between a department executive and his subordinate staff, the lion's share going to the executive. This is a hard pill for the subordinate

to swallow although one with a military background may find the condition quite natural. Nevertheless even to one whose previous experience enables him to understand this practice, it will always be discouraging. Generally the department executive feels that the reward for good work within his department is due to the organization, and primarily to himself as the contact point between his department and the rest of the establishment. However he is usually broad minded enough to realize the importance and necessity of surrounding himself with well equipped and efficient subordinates. On the other hand he is apt to take the very heart out of the bumptious recruit who he feels must be trained to subordinate himself and his interests to the interests of the chief, and it is with alarm and distrust, if not open enmity, that he views the individualistic tendencies of his new subordinate. Where the industrial recruit happens to have had the military background, he can appreciate thus subordinating one's self to an organization, but cannot understand it in its full industrial meaning.

One of the principles of the industrial battle has been so thoroughly broadcasted, that it is almost accepted as one of the main foundations of industry: "The office boy of today may be the president of tomorrow." In other words, it is the belief that the trained recruit to industry of today, regardless of position, may become by merely making manifest his training and ability, the hand which will guide the vast wheels of his industry of tomorrow. Therefore, to find himself held down and bound with petty red tape and short sighted policies of those under whom he is appointed to serve his apprenticeship, is so discouraging that it takes the truest and most perfectly balanced will power to meet and master successfully.

Outwardly, this type of industrial chief is the most pleasant to his subordinates, is thoughtful of their feelings and is ever portraying the possibilities of the future and what they will mean to the young man, yet year after year passes without promotion or recognition other than perhaps small financial ones, until at last acceptance of the situation is made by the once ambitious recruit or else he breaks. Nevertheless there is a way, a tactful way, of presenting the true situation to those in power: He must acquire a *thorough knowledge of the organization of which he is a part.* This is the surest way of obtaining recognition; advancement must follow, and the victory is his. The immediate chief chooses to regard such a recruit as the finest product of his training. Tactful subordination entails the sacrifice of many hardwon solutions of organization problems for which the recruit alone has been responsible; nevertheless he is the ultimate victor, having learned well the lesson of the value of accepting in his turn the suggestions of subordinates and administering fairly the rewards due them. It is a big thing to master which means the broadening view of the ultimately successful executive.

The fighting army has developed itself fully in the ages of experience as to organization; its various branches are well defined and the attitude of its personnel in organization is so clearly mastered that rank is well understood and recognized by distinctive insignia and uniform. The industrial army, however, although carrying all the prejudices of caste of the fighting army, has no helpful insignia to guide, and often the status of the lesser grades is in doubt even to those most closely connected with them. Snobbery of a sort not excelled elsewhere is found in the industrial ranks and it is the most difficult to understand because of its often intangible and indefinite lines.

Departmentalism is a rampant disease in the industrial world of which the foreman is the high potentate wielding a power. He is jealous beyond a believable degree of his rights and power, and whether the industrial recruit meets him in the capacity of a subordinate or in that of a representative of the industrial staff of the plant, his contact must be made with the fullest deference and tactful consideration else discharge, if he is a subordinate, or refusal to co-operate, if he is a staff representative, will be his lot. Clearly, the volumes of printed pamphlets assuring the industrial world, and all others who care to read, of the spirit of co-operation that is the lot of the industrial private and of the many considerations that are extended to the industrial recruit, of the unlimited opportunities that are his and of the untrammeled freedom for his initiative, if he will exercise it, are true only in so far as the recruit refrains from transgressing the fixed laws of the caste, which are set up to a greater or lesser degree in every industrial plant.

Few managers or superintendents can honestly get away from the idea that they are superior to the rest of the organization. The industrial privates for many reasons which have little or no foundation for existence, look down upon each other, and as for the president or vice-president, he and Napoleon are but slightly different in the eyes of the industrial private—either as a tyrant supreme or a benevolent philanthropist, or sometimes, when the plant is small enough to warrant it, as a personal friend.

It is undeniably true that every fair and broadminded organization in industry is fighting, and fighting hard, this tendency towards highly developed caste, yet it is a much mooted question as to the best means and methods to employ in combatting it, for while some plants may find that they have mastered class feeling, it must still be measured in degrees of accomplishment rather than in successful completion of the task.

So the recruit to industry may feel that he has indeed reached a world of strange habits and methods, far from the ideal of which he has read—the "pull together," "work together," "all for one, one for all" world of industry—and he is amazed, confused and sorely tried at the changed attitude and aloofness extended him because of his unfamiliarity with caste rights and prejudices. He is viewed with suspicion as

to his intentions or reason for being in the plant at all, with envy and distrust of his knowledge and training, and, above all, an attitude of defiance toward such promotion as may come his way because of his application and ability through previous training to master quickly problems which the industrial worker of long standing has failed to solve.

But industry will welcome the trained man. That the recruit to industry is from a different world, is a foregone conclusion, so far as the feelings of the industrial unit are concerned, regardless of whether that field is the army or other professional walk of life. He may make the path the easier and the judgment of his co-workers in his favor if he will accept the new environment with the standards he finds set; tactfully avoiding the mistake of injecting the methods or habits of his old environments into the new until he has gained in a measure the confidence and respect of the men who will mean much to him in the success or failure of his work. He must remember always that *he* is coming to the new field and that he must show his ability to stand to his guns, in man fashion, or, as the industrial world puts it, "stand the gaff," meeting the industrial rules of the industrial sector as they are laid down, then many helpful hands will send him on his way to success.

The real attraction of the industrial sector for the worker as well as for the investor, the financer and the promoter, is the ever alluring possibility of rapid and rich return in position or power and in the increased earning capacity brought about through wider fields of activity and the broader vision of the great industrial centers. As great numbers, both competent and incompetent, are brought into the industrial field, either by choice or necessity, the tried veteran of the industrial sector is apt to view with much contempt any so-called "white collar" recruit until his fitness has been substantially proven to begin the work he hopes eventually to master. This attitude is rather apt to be the rule than the exception and in a great measure performs a real and valuable service in maintaining a sifting of raw material and bringing out the finer sides of the industrial recruit, while decidedly discouraging the unfit who are handicapped with too ready a tongue and too little gray matter to support it.

The men in the ranks and the semi-executive care little for the fact of a carefully prepared training if there is an attempt to secure position or prestige with that alone, and there are still many industrial chiefs who look upon a university training or any scholastic background, as a thing to be regarded as a hindrance if the recruit attempts to capitalize on it alone. The school of experience, in their eyes, coupled with sound common sense, makes up for any deficiency in theoretical training, for, as dividend paying results are demanded, little patience is given to the development of untried theories without very definite assurance of an improvement. This is particularly trying to the enthusiastic recruit

of vision and his problem is one requiring much patience if he is depending upon this phase alone to prove his worth and gain promotion.

The demand of this age of industry is for men of broad vision but they must first know their field perfectly, know it so well that, be it a department or a plant, they can safely launch their theories or visions with sound practical backgrounds of analyzed facts. It is not needful that the recruit become a specialist in all lines, but he must be well grounded in the fundamentals and must be able to visualize the whole if he is to gain the cooperation and support of his chiefs and his subordinates, and this, in short, means that he can best accomplish his purpose with balance, which is the exceedingly valuable asset of using his own experience with that of the accumulated experience of men who have been successful in his chosen field of industry. To such a man, success *will* come and the attitude of the industrial army will be only that of respect, approval and support.

While the gloss of civilization and the inherent American characteristic of giving a fair chance to the beginner are generally the practice, it nevertheless remains a fact that he who has the power to take, will take, and he who can hold what he has taken, will hold it. It is with this perhaps very human trait in mind that every recruit should guard against the danger of failing to protect himself from the many pitfalls of believing too sincerely in the support of a foundation built upon other than the knowledge he has acquired by association with those who have proven their responsibility capacity.

The industrial veteran views with little regard the recruit to industry who has no plans, no ideas, or scant determination as to his future development and extends little in the way of support to the one who is "just trying it out," or who feels that beause of his background he is equal to any or all of the big divisions of the industrial army. The veteran industrial unit fought hard for his place along very definite lines and his success was measured solely by his ability to outpoint the other fellow, and he maintains his vantage point by out-thinking his job every day in the year. He cannot see at all why the recruit, no matter what his former training might have been, does not know what he can do best with some degree of certainty, when practically every branch of human activity is opened to him in the four main divisions of the industrial army.

The recruit, knowing his own limitation, should be able to qualify under any one of the following main divisions into which the *Industrial Sector* is divided.

Accounting:	Routine mathematics and book-keeping.
Finance:	Investments, credits and exchange.
Production:	Mechanics, machinery, engineering and power.
Marketing:	Advertising, sales and merchandising.

The knowledge of these four channels and the legion of sub-divisions

into which they are divided should enable the recruit to come to industry prepared to take his place with some degree of purpose and thereby gain the support of those who can help him most by the knowledge they have gained in the specific work he has chosen. Too often do we find the "Jack of all trades" still floundering about in his generalities when less capable co-workers are gaining their vantage points because of definite application to a specific phase of industry. Such definite application helps beyond measure in the later balancing of power in the broader jobs and makes the most important of the foundation stairs to success.

Most recruits—there are men who do not attempt it through timidity or fear of ridicule—set a value upon themselves before they are fully aware of their ability to anywhere nearly solve the problems that they have to meet, and the industrial veteran either enjoys the situation hugely or admires the colossal assurance that prompts him to say, "Go to it, son, but sooner or later you are doomed to a fall."

The important fact that must be met squarely is that the industrial recruit must produce or, failing that, must be trained to produce, and if his training and experience have fitted him to produce at once, he can, perhaps, reach approximately the financial valuation of himself, but if he must fit himself to his job, satisfy his chief of his ability to stand on his feet, and gain the support of his subordinates, it is both unwise and unprofitable to set other than a fair living financial return upon his services; the higher the rate of value he places upon himself, the more severe will be the criticism, the more strictly will he be held to an accounting and, if his ground is uncertain, or his ability to hold and produce on his chief's investment in himself is doubtful in his own mind, then indeed a sorry future awaits him, for it may destroy his entire industrial value. The first year is, at best, one of appraisal and adjustment of values, and it is a wise policy, indeed, to temper ego and conceit with stern facts which will permit a less vain-glorious start but which will assure a future of real development, both financially and in the knowledge that a real foundation is being laid.

The man within the ranks of industry is much the same as his brother on the outside, but he is fighting a desperate fight, for the existence of himself and his own. He is fair, ready to help, ready to serve, but in considering the new recruit to the firing line of industry, he fears new burdens, new demands upon his resources in maintaining and carrying those who do not prepare themselves or who are indifferent to the fact that industry is a constant struggle requiring every man to stand upon his own feet. The recruit may approach his industrial adventure with the attitude that "the world owes every man a living," the industrial veteran is equally emphatic in his attitude of "all right, brother, you say the world owes you a living and you are coming to the industrial sector to get it; very well—go ahead and prove that you are *worth* the living and I am with you."

Land Artillery to the Fore

By Major Sanderford Jarman, C. A. C.

AT this time when the eyes of the world have been centered on the Conference for the Limitation of Armament which has been held in Washington, one naturally reads much about the power, armor, and armament of capital ships. This brings to mind the great progress in naval artillery that has been made as the result of the large naval building programs that the principal maritime countries have instituted in late years. Any consideration of naval craft is one of great interest and importance to the Coast Artillery. Having in mind the past history and present condition of the harbor defense artillery it is the purpose of this paper to give a brief description and point out the capabilities of some of the new types now building. This will show how the land artillery is to the fore when compared with naval artillery. In this discussion all data will be restricted to the primary armament. In developing the general subject it is necessary to give a brief historical resumé and certain statistical data in so far as our land artillery is concerned, and which will for sake of brevity be restricted to the period from 1886 to the present time. The year 1886 is selected as it was at this time that the well known Endicott Board report was submitted to Congress. This report was complete, comprehensive and far reaching and forms the basis of the present day coast defense system.

At the time of the submitting of the Endicott Board Report to Congress we find in foreign navies the following conditions:

Country	Number of Ships	Calibre of Guns	Range in Yards
England	12	12-inch and 17-inch	Over 17,000
France	19	11-inch and 16-inch	Over 17,000
Italy	5	17-inch	Over 17,000
England	1	16-inch	Over 15,000
France	8	9-inch and 11-inch	Over 15,000
Italy	2	17-inch	Over 15,000
Germany	12	10-inch and 12-inch	Over 15,000

The coast defenses of the United States were at this time equipped with the following armament:

Kind of Gun	Number	Description	Range Yards
Rodman, smoothbore	2	20-inch	
Rodman, smoothbore	308	15-inch	4,322
Rodman, smoothbore	998	10-inch	3,976
Rodman, smoothbore	210	8-inch	3,746
*Parrott guns, rifled	38	300 lb. proj.	
*Parrott guns, rifled	81	200 lb. proj.	
*Parrott guns, rifled	173	100 lb. proj.	7,906
Converted rifles	210	8-inch	

*Of doubtful value.

It is at once apparent that the land artillery of this time is in no way comparable with the naval artillery. The superior condition of the naval artillery can best be understood from the following quotation from the Endicott Board report:

"It is impossible to understand the supineness which has kept this nation quiet—allowing its floating and shore defenses to become obsolete and effete—without making an effort to keep progress with the age, while other nations, besides constructing powerful navies, have not considered themselves secure without large expenditures for fortifications, including armored forts."

Without discussing the various conditions and influences that were exerted on the types developed as a result of the Endicott Board report, it is desirable to pass to the year 1896. During the period from 1886 to 1896 there were installed in the harbor defenses 18 batteries of 12-inch mortars with 8 mortars to a battery. These mortars were for the most part the model 1890. In addition to the mortars there were 8 batteries of 12-inch guns—totaling 17 guns, of which the majority were of the model 1888. The maximum range with the mortars was about 12,000 yards and that of the guns was under 15,000 yards. Foreign navies continued to lead in power by installing 12-inch, 45 calibre guns with an increased muzzle velocity as well as materially increasing the quality and thickness of the armor carried.

The next period for consideration is from 1896 to 1906. In so far as land artillery is concerned practically the same program as to types, calibre and power was continued. A total of 232 12-inch mortars and 86 12-inch guns were installed. The navies of the world during this time brought forth the dreadnaught type of ship, carrying as many as 10 12-inch 45 calibre guns and over 11 inches of armor. The land artillery installed and the type of emplacement used were in general of the design of 1890.

In the period from 1906 to 1916 we find the cannon installed in the harbor defenses altered very little in types and characteristics. Some few 14-inch guns mounted so as to give a range of 16,890 yards were emplaced. Not over twenty-five were fabricated. These guns were not

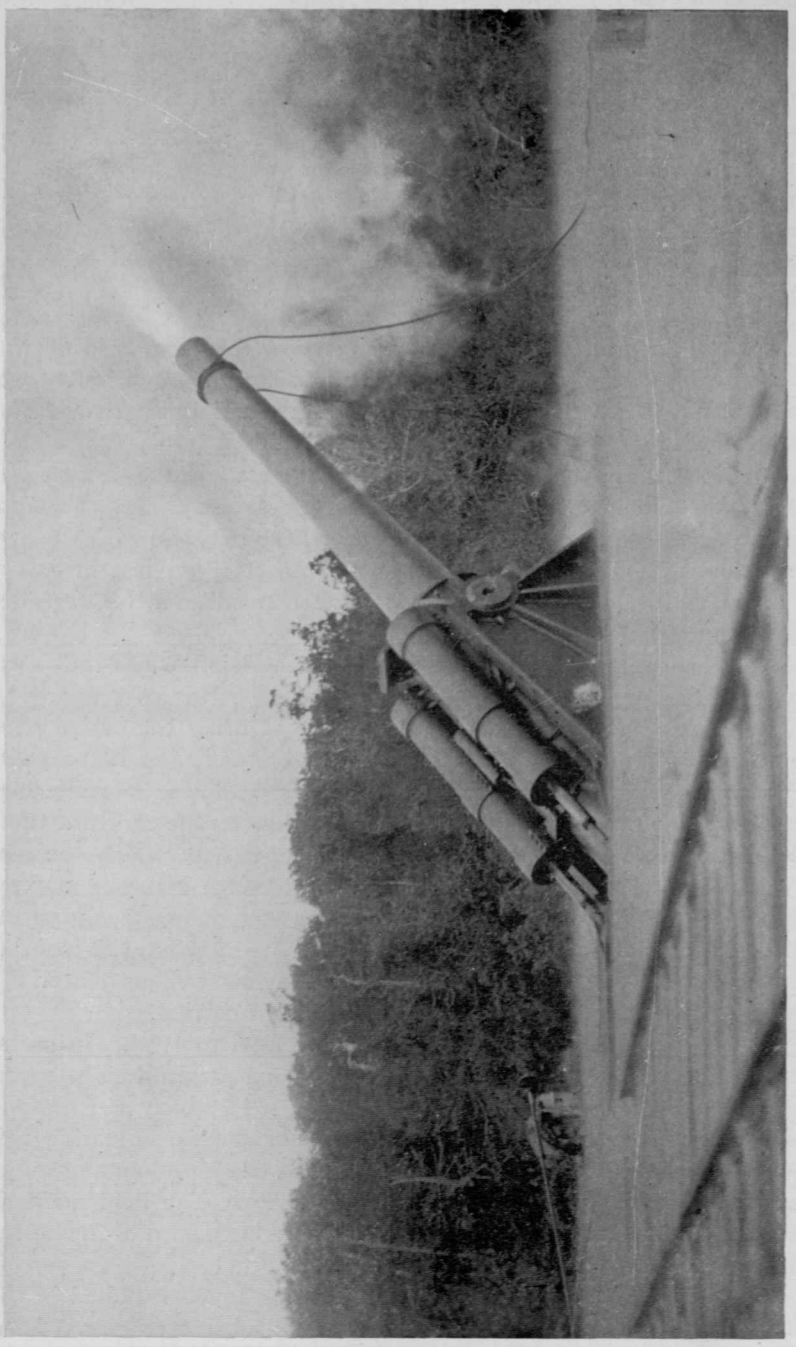


FIG. 1.

adopted as a type so much to obtain increased ranges as they were to increase the life of the weapon by reducing the muzzle velocity. The decreased muzzle velocity with the increased calibre gave the same striking energy as the 12-inch gun did with consequent increased life of the weapon. In addition 32 12-inch guns were mounted on a new type of barbette carriage so that a range of approximately 28,000 yards was obtained. Figure 1 shows this type of gun. It is interesting to note that this is the first departure from the standard type of disappearing carriage that had been used for mounting the greater majority of the then existing shore artillery By the adoption of the barbette type of carriage at this time, for these 12-inch guns, land artillery was well on its way to the high state of development that will be brought out further on. The disappearing carriage cannot be used to mount guns so as to permit of the maximum range and power thereof being obtained. It is not intended to discuss the merits and demerits of the disappearing principle. These new mountings for the 12-inch guns giving this increased range were an effort to meet the great developments made in naval artillery. A glance at the armament mounted on foreign ships shows that they had at this time in commission vessels carrying 12 14-inch and 15-inch, 50 calibre guns. Recent studies indicate that it will be possible to obtain with a lighter type of projectile a range of about 31,000 yards with the 12-inch gun mounted on barbette carriage shown in Figure 1. The question as to the employment of these guns in the most efficient manner makes it necessary to study some of the possibilities of this weapon. Figure 2 shows the percentage of hits that can be expected at various ranges. This chart has been made up from a purely theoretical computation. No data from firings have been included. The purpose of the chart is to bring out certain principles. A study of it shows that within short ranges more hits will be obtained on the belt than on the deck and likewise the range table indicates that the belt will be penetrated. As the range increases, penetrating the belt armor becomes more difficult, also the angle of fall is such that it is doubtful if the projectile will bite on the deck armor. This condition continues for some time as the range increases until finally a range is reached such that the projectile cannot penetrate the belt armor but the angle of fall permits of it biting and penetrating the deck armor. In order that the zone of fire where penetration of the belt armor cannot be expected and the angle of fall does not permit of biting on the deck armor, may be effectively covered, resort may be had to zoning the gun in somewhat the same manner as a mortar. The possibilities of doing this are indicated in Figure 3. A study of this chart indicates that it will be possible by the use of reduced charges to obtain an effective zoning of this gun.

This period from 1906 to 1916 embraces the outbreak of the World War in 1914. At this time we find that the harbor defenses of the Con-

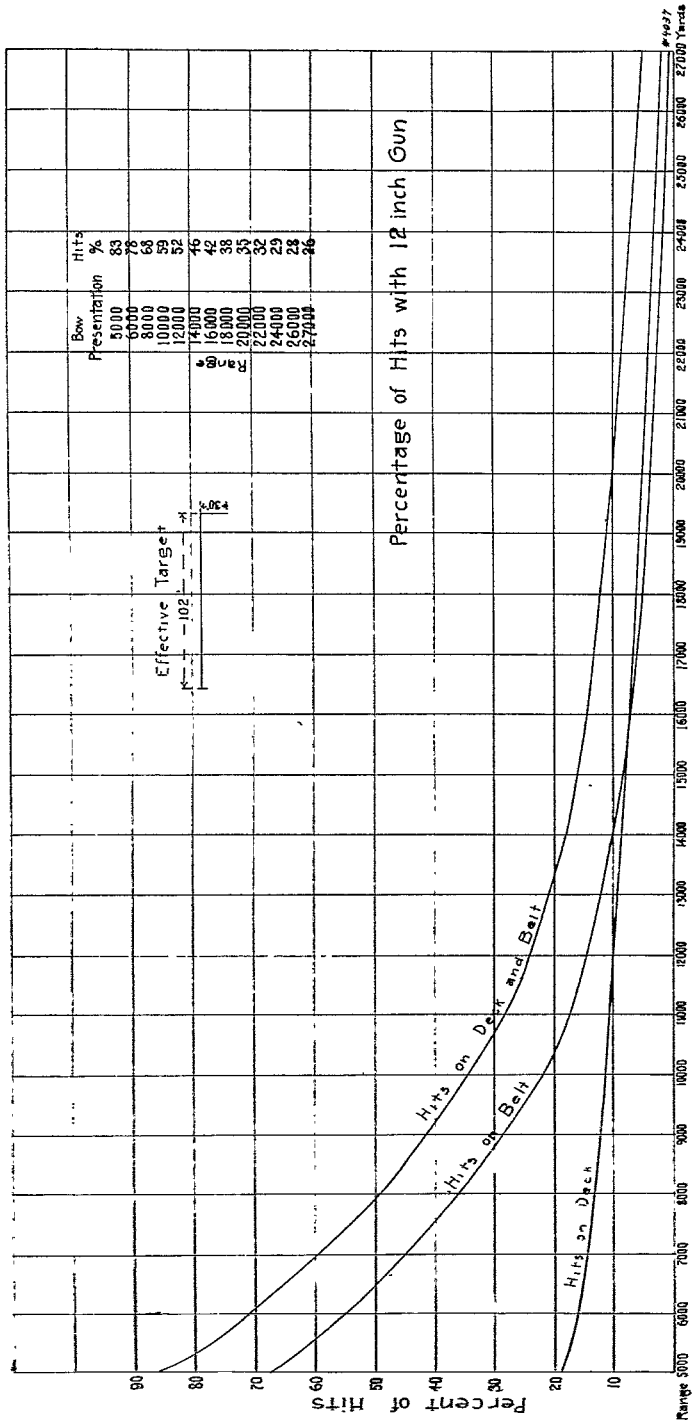

Percentage of Hits with 12 inch Gun
Percent of Hits
Range
Hits on Deck and Belt
Hits on Belt
Hits on Deck
Effective Target
Bow Presentation
Hits %
5000 83
6000 78
8000 68
10000 59
12000 52
14000 46
16000 42
18000 38
20000 35
22000 32
24000 29
26000 28
27400 26

FIG. 2.

tinental United States had major calibre artillery installed practically as follows: from Portland, Maine to Galveston, Texas approximately 270 12-inch mortars and 80 12-inch guns; from San Diego, California to Puget Sound, Washington approximately 100 12-inch mortars and 25 12-inch guns. Many of these guns, in fact the majority of them, were designed prior to the Spanish American War. In 1898 we find 15,000 ton capital ships of foreign navies equipped with 4 12-inch guns, protected by 14 inches of armor and capable of a speed of 17 knots. These same navies in 1914 had 30,000 ton ships equipped with 14 12-inch guns, some with 8 15-inch guns, protected by 12 inches of K. C. armor and capable of a speed of 25 knots. In other words the navies have had their artillery powers doubled in a period of about 15 years. With the completion of this type of ship so heavily armored and protected, naval artillery had indeed become very powerful. To enable such large ships to be built, the structural strength of the vessel was increased permitting, after 1910, of the installation of guns capable of firing at angels much in excess of 15 degrees. This of course practically doubled the range of naval artillery. It was this same increase in the power of naval artillery that permitted the Allied Fleet to lie outside the range of shore artillery during the attack on the Dardanelles and the Belgian coast, and bombard them. In the case of the Dardanelles a number of forts were silenced. This increased range of naval artillery enables hostile vessels to reach points which land artillery should be able to defend.

It was not long after the World War began when we read in the papers daily accounts of the easy capture of Belgian fortresses and their inability to withstand modern movable land artillery. These fortifications had been constructed for the most part during the previous thirty years. The natural reaction in the United States was the questioning of whether our harbor defenses could compete with modern naval artillery, this artillery of recent installation and the land artillery not having been improved upon for years. There is no doubt but that the decision of the War Department in approving the recommendations of the Board of Review to construct a 14-inch Railway Gun and a 16-inch railway howitzer, can be traced directly to the important part then being played in Europe by high powered artillery. The work of designing these railroad mounts naturally moved slowly as all the enginering talent in the United States that had been engaged in designing and building shore artillery had devoted its time to fixed types of artillery. The Board of Review also recommended at this time that the major calibre direct-fire gun installed in the future should be of at least 16-inch calibre, and the adoption of the 16-inch mortar as the type of mortar for future installation. The United States entered into the war before any pilots of these new types of artillery could be manufactured and tested.

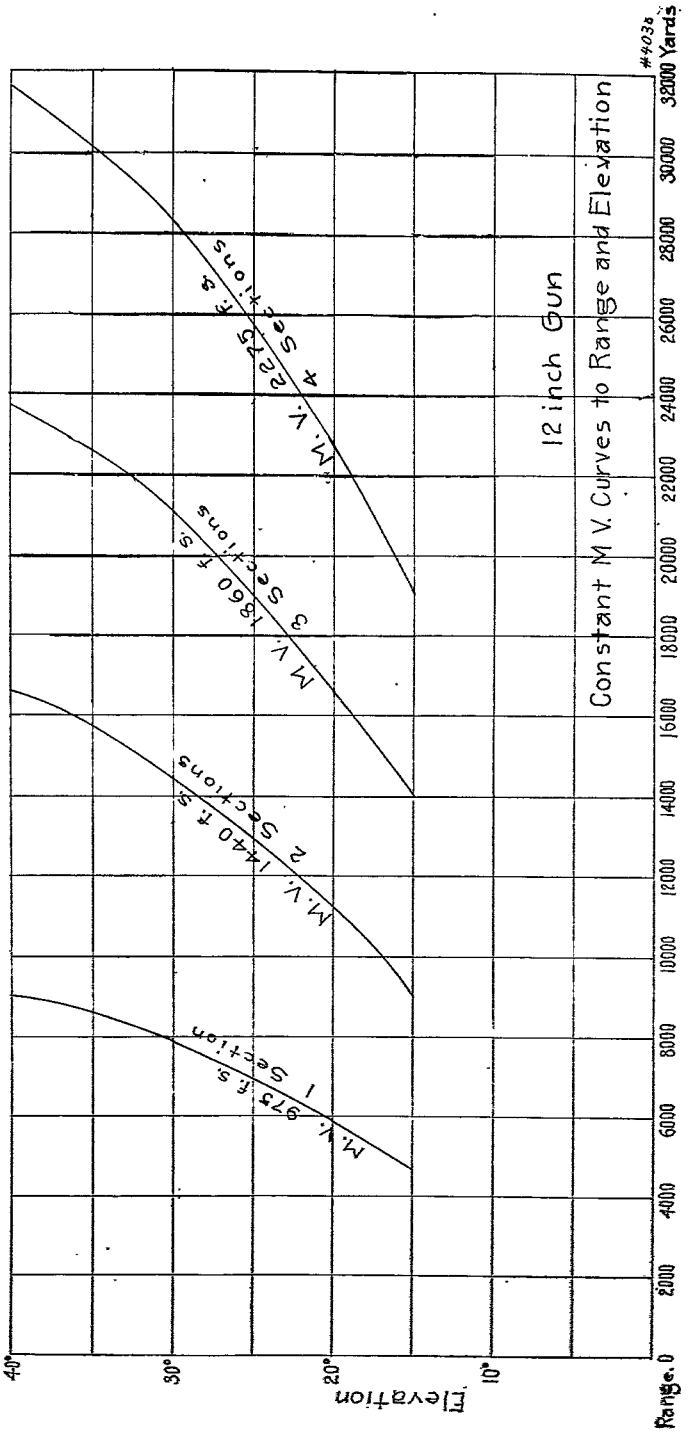

12 inch Gun
Constant M V. Curves to Range and Elevation
#4038
Yards
Range. 0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
28000
30000
32000
Elevation
10°
20°
30°
40°
M. V. 975 f. s.
1 Section
M. V. 1440 f. s.
2 Sections
M. V. 1860 f. s.
3 Sections
M. V. 2275 f. s.
4 Sections

Fig. 3.

Soon after the United States forces arrived in France demands were made for high powered long range railway artillery capable of coping with the activity of the Germans along this line. Under the stress of war it was necessary to produce artillery for the especial purpose of attacking specific types of targets on the Western Front. These targets were heavily fortified strong points, forts and railroad centers in the German main line of resistance. In producing this artillery quickly it was necessary to design it on simple lines. The main object was to provide, in the shortest possible length of time, the maximum number of guns that would be satisfactory for land warfare. The following table indicates the program of heavy land artillery to be employed in France.:

Calibre	*No. of Carriages*	*No. of Guns*
5-inch and 6-inch guns	120	199
8-inch guns	62	107
10-inch guns	72	117
12-inch guns	15	20
12-inch Mortars	91	100
14-inch guns	60	120
16-howitzers	40	80

The majority of these calibres of guns below 14-inch were to be obtained from the harbor defenses. At the signing of the Armistice this program had been partially completed. Where construction had proceeded well towards completion the units were finished, resulting in there being now on hand the following number of railway artillery units:

7-inch Guns	12
8-inch Guns	48
12-inch Mortars	91
12-inch Guns	15
10-inch Guns	18
14-inch Guns	14
16-inch Howitzers	2

From the above table it will be seen that of the original program only 200 railway mounts are now on hand and available for use in coast defense or for supporting a field army. The opportunity was taken at the time of providing railway mounts for these old cannon so to mount them as to permit the maximum range of the gun being obtained. The following table indicates the increased ranges resulting from this change of mounting:

Range in Yards On Fixed Carriage	*Calibre of Cannon*	*Range in Yards On Railway Carriage*
11,000	8-inch gun	22,000
12,250	10-inch gun	27,000
15,300	12-inch mortar	15,300
12,000	12-inch gun	29,000
16,870	14-inch gun	45,000

The knowledge gained by the Ordnance Engineer in constructing under war time pressure this large program of railway artillery has been particularly beneficial in the many new problems that had to be solved in the design and construction of the new 16-inch guns and howitzers and the 14-inch railway unit model 1920. Many new developments and improvements have been made in the design of artillery consequent on the necessity of mounting shore guns so as to obtain the maximum range and full power of the weapon.

There is no doubt but what the opportunity given during the war of constructing high powered artillery has paved the way to present superiority of land artillery over naval artillery. This superiority of the new types of land artillery will be apparent as their characteristics are studied.

Prior to going into the details of the characteristics of these units it is desirable to consider in a very general way some of the influences that have caused the adoption of these mounts with the characteristics as they exist. These weapons are post war products and there have been embodied therein the lessons of the war. The development in capital ships has had a marked influence on the new types of heavy land artillery. One of the first things that stands out in studying foreign battleships is the marked degree in which they have increased their armor protection. The Germans were able to get back to port after the Battle of Jutland due no doubt to their superior armor protection. It appears that the Germans had gone in for long range gunnery more than the British and in so doing they had been also better able to appreciate the necessity of providing increased deck protection capable of withstanding high-angle fire A number of British ships were lost at Jutland, due no doubt to the fact that their decks were inadequately protected. All information points to the fact that new capital ships will have a belt of 14 inches of K. C. armor and a protective decking of from 7 to 8 inches. The naval artillery now carried amounts to as much as 8 16-inch 50 calibre guns or 12 14-inch 50 calibre guns so mounted as to obtain 40 degrees elevation. Vessels of this type having a tonnage of 42,000 tons and a speed of 35 knots cannot fail to have a great influence on land artillery construction. A study of the results of the Conference for the Limitation of Armament shows that only the following ships equipped with 16-inch guns will be completed:

Country	*Name*	*Number of 16-inch Guns*		*Tonnage*
United States	Maryland Washington Colorado	8		43,000
England	13 ships each	8-15-inch guns	1- 2- 10-	43,000 32,000 31,000
Japan	Nagato	8		35,000
	Mutsu	8		35,000

Efficiency and economy direct the adoption of both fixed and railway types of artillery. This is due to the fact that there are limitations as to the calibre of gun which can be mounted on railway carriages, and the necessity of providing in certain localities the most powerful gun as yet developed.

The trend of development has been for years, in so far as naval armament is concerned, towards an increase in size, power and range. Realizing this, it is desirable to secure for land artillery superior power in order to anticipate future development in naval armament. It has been pointed out that there are certain localities that demand the installation of fixed armament, these being either on islands or otherwise so inaccessible that no advantage could accrue from mounting them on railway mounts. Certain of these localities could be protected by 16-inch howitzers at less cost than if 16-inch guns were employed. This would account for the two types of 16-inch cannon.

In the adoption of the 16-inch 50 calibre and the 14-inch 50 calibre guns it is interesting to note the qualities considered necessary to be secured which give land artillery the supremacy.

(a) *Long range offensive power.* As has been pointed out the development during the past 30 years in naval artillery has been distinctly towards long range power and accuracy. This received an accelerated development during the World War. The writer recalls that during joint maneuvers conducted between the Coast Artillery and the Navy a short time prior to the World War, a detailed study was made of the possibilities of a direct bombardment of one of the forts. The figures are most interesting. It was considered that five divisions of capital ships were firing one shot per gun per minute from the primary armament into one fort. This made it possible to place 152 major calibre projectiles in the fort each minute. On the basis of allowing 33-1/3 percent hits there would have landed in the fort one and one-half tons of high explosive and twenty tons of shell per minute. All this firing would have been conducted from ranges beyond the fire of the shore artillery. Conditions such as this could not now exist with the new types of land artillery.

(b) *Maximum rates of fire.* Notwithstanding the fact that the enemy is engaged at longer ranges and therefore under fire for a longer length of time in case of a determined attack the consideration of speed of fire is still of importance. At these long ranges the probability of securing hits is small, necessitating an increase in the rate of fire, which is obtained in the new types of land artillery.

(c) *Mounted for effective use at all ranges and in every direction.* Land artillery as at present installed is, as has been pointed out, limited by the type of mount in both elevation and traverse. From the description of the new mounts it is readily apparent that no such limitations exist. There have been no firings made to determine the relative accuracy of the 16-inch Howitzer and the 16-inch Gun fired with reduced charges. Notwithstanding this lack of data there is no reason to believe but what the 16-inch Gun with reduced charges will be as effective and accurate as the 16-inch Howitzer provided proper powder and powder charges are used. When necessary to fire at short ranges there is no reason but what the 16-inch gun will perform all the functions of both direct and high angle fire weapons. This provides a unique type of artillery of unlimited potentialities.

(d) *Simplicity in design, small target, low cost of emplacement, and easiness of camouflage.* These necessary qualities have been secured as will be seen from the following description.

DESCRIPTION OF THE 16-INCH BARBETTE GUN AND MOUNT

GUN:

Length in calibres	50
Weight of projectile, pounds	2,340
Weight of Powder charge (approximate), pounds	900
Length of powder charge (approximate), feet	10
Muzzle Velocity (approximate) f.s.	2700
Muzzle Energy	124,500 foot tons
Weight, pounds	340,601
Weight of gun and cradle, pounds	550,000
Estimated rate of fire	1 shot 40 seconds

CARRIAGE:

Maximum elevation	+65°
Minimum elevation	−7°
Loading angle	0°
Maximum traverse	360°
Means of loading	Hand or electric driven power
Means of elevating	Hand or power
Means of traversing	Hand or power

As has been stated this unit has incorporated in it the lessons learned from the World War, and will outrange any guns now mounted or con-

templated for naval craft. The unit is simple in design but there have been omitted none of the essentials for securing rapid and accurate loading and maneuvering of the gun and carriage. As will be seen from Figure 4 it is similar in the general type of construction to the 12-inch mortar carriage.

Both hand and power traversing systems are provided. The power is furnished by electric motors connected to hydraulic speed gears. The hand power is of the conventional type easy to operate by two to four men. In order to set the gun in elevation, electric motors and hydraulic speed gears are provided with which it is possible to lay the gun at any elevation within an accuracy of one minute. In order to prevent shock when the gun comes to rest at the limits of elevation and depression, automatic stops are provided. In addition to the power

FIG. 4.

elevation a delicately balanced hand power set of gears has been installed that can be operated by one man. This is obtained primarily by the use of roller bearings at the trunnions. The recoil of the gun is taken up by four oil cylinders in the walls of which grooves have been cut through which oil is throttled as the piston rods and heads move to the rear with the gun. An air recuperator system is provided. This was made necessary due to high elevation (65°) at which it is contemplated to use this gun. Two air cylinders with pistons are used, under a pressure of about 1800 pounds. This holds the gun in battery. When a round is fired the air in the recuperators is further compressed and this supplies the necessary energy for returning the gun into the original position for the next round. In order to take up the excessive counter recoil action set up by a recuperator system designed to function at 65 degrees, when the same system works at low elevatons, a special counter recoil buffer mechanism is provided which works without any difficulties.

As has been previously pointed out it is necessary to provide a high rate of fire in order to secure hits by volume of fire with guns of this type when used at long ranges. In order to do this there was first installed a new type of breech block shown in Figure 5. This block is

of the drop block type which when opened, drops compressing a set of springs which aid the closing of the block. The block is closed by the use of compressed air. When it is noted that the projectile and powder will weigh approximately 2400 and 900 pounds, respectively, and when it is realized that the length of the powder charge will be approximately 10 feet, one appreciates some of the difficulties in securing a rapid rate of fire. In order to secure a rate of fire of not less than one shot per minute, and possibly more, a power rammer has been located on the racer near the breech of the gun. A platform on the racer will provide

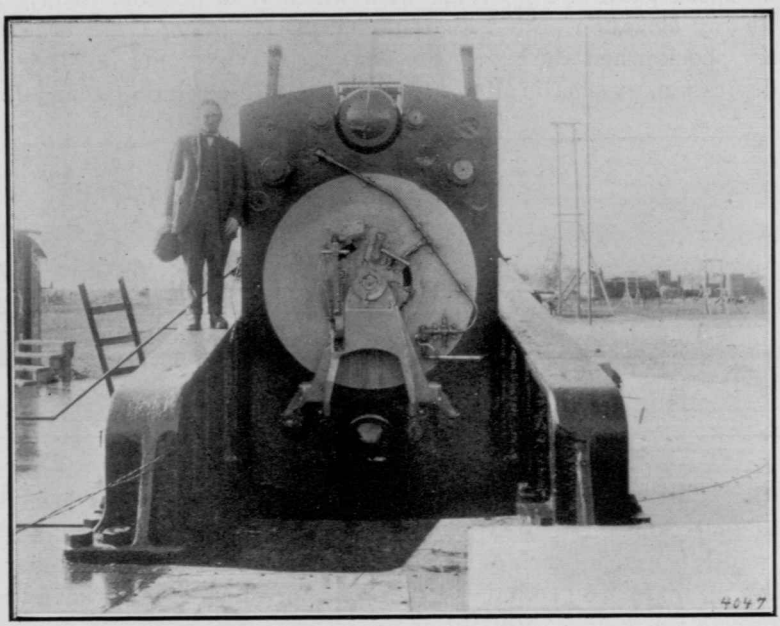


FIG. 5.

for the holding of about six projectiles ready for the power rammer to load into the gun. The rammer is driven by an electric motor connected through a hydraulic speed gear. The emplacement for this unit will be a simple concrete block. There will be a standard gauge railway track leading to each gun and extending circumferentially around the block. A specially designed car carrying ammunition will be able to deliver powder and projectiles to the ammunition platforms on the gun no matter in what direction the piece is pointing. In order to permit of laying the piece there are provided two telescopic sights, an azimuth circle, a range disc and an elevation quadrant. The range disc is so constructed that it can be quickly removed and replaced. Several of these discs corresponding to various muzzle velocities will be provided. It is at once apparent that either case I, II or III may be used in firing this weapon.

A small air compressor driven by an electric motor is attached underneath the racer of the carriage. This compressor furnishes air for the operation of the breech block and ejecting powder gases from the bore of the gun after each round. The use of air for ejecting the powder gases from guns has not been in general use in the Coast Artillery. By using air to eject the gases after each round there will be no danger of flare backs, sponging will be eliminated and an increased rate of fire made possible.

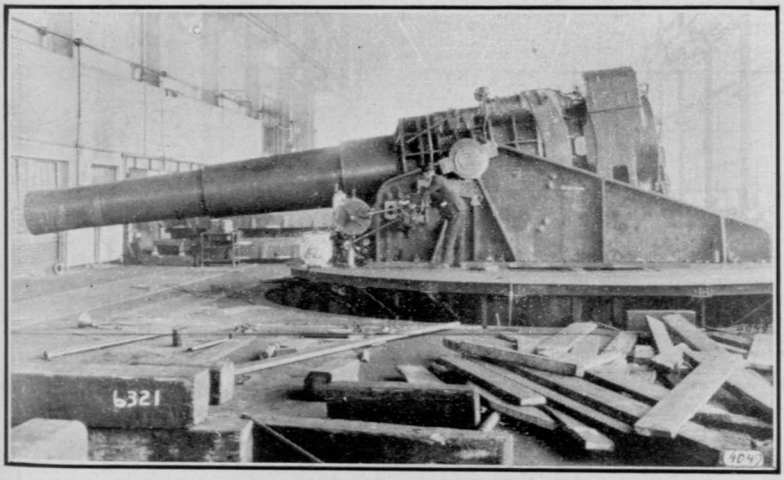


FIG. 6.

DESCRIPTION OF THE 16-INCH BARBETTE HOWITZER AND MOUNT

GUN:	
Length in calibres	25
Weight of projectile, pounds	2,340
Weight of powder charge (approximate) pounds	350
Muzzle velocity, f. s.	1,850
Estimated rate of fire	1 shot in 40 seconds
CARRIAGE:	
Maximum elevation	+65°
Minimum elevation	−7°
Loading angle	0°
Maximum traverse	360°
Means of loading	Hand and power
Means of elevating	Hand and power
Means of traversing	Hand and power

The 16-inch howitzer unit is in all respects similar to the 16-inch gun. A study of Figures 6 and 7 show this great similarity. The various parts are of smaller dimension, and lighter construction is used through-

out. This unit has exactly the same facilities for elevating, traversing, pointing and aiming as the 16-inch gun, the following being provided: power rammer, gas ejector, system, two telescopic sights, azimuth circle, range disc, and elevation quadrant. In short the 16-inch howitzer unit is a miniature edition of the 16-inch gun unit.

Due to the gun characteristics of this weapon it is interesting to note the possibilities of employing it within a range of 10,000 yards as a direct fire weapon. An increased rate of fire can be obtained due to not having to wait for the bell. The armor perforation is greater as a direct fire weapon as shown by the following:

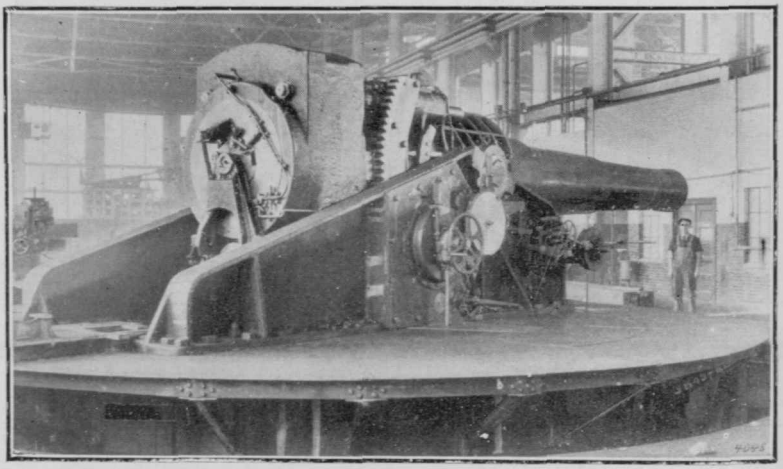


FIG. 7.

Range	*Perforation inches*		*Angle of fall degrees*	
Meters	*Direct fire*	*High angle*	*Direct fire*	*High angle*
2000	18		2	
6800	14	5	8	57
8000	13	4	10	56
10000	11		13	

The possibility of hitting when employed as a direct fire weapon is equal or greater than when used for high angle fire. The following table indcates the danger space for a target 625 feet long, 25 feet high and 80 feet wide:

	Broadside		*Bow on*	
	Danger Space	*Danger Space*	*Danger Space*	*Danger Space*
Range	*Vert. Targ.*	*Hor. Targ.*	*Vert. Targ.*	*Hor. Targ.*
2000	233	27	170	208
4000	109	27	170	208
6000	73	27	150	208
8000	50	27	116	208
10000	31	27	94	208

Considering the ordinary presentation of naval vessels to land artillery, the danger space for the howitzer as a direct fire weapon will equal or exceed the howitzer as a high angle fire weapon. It is also necessary to consider the large portion of the horizontal target that is covered by turret tops, which is as much as 40 per cent for capital ships. As the thickness of these tops is as great as 7 inches it is doubtful if effective penetration could be obtained. By employing this weapon as a direct fire piece the trouble of not arming the fuze at low rotational velocity will be eliminated and thereby insure a greater percentage of effective bursts.

DESCRIPTION OF THE 14-INCH RAILWAY UNIT, MODEL 1920

GUN:	
Length in calibre	50
Weight of the projectile, pounds	1,560
Muzzle velocity, f. s.	2,700
Weight of powder charge, pounds	460
CARRIAGE:	
Traverse, degrees	360
Elevation, degrees	−5 to+50
Loading angle, degrees	−5
Minimum firing angle, degrees.	0
Total weight of unit, estimated, pounds	500,000.

The Frontispiece shows a photograph of the pilot carriage of the new mounts. This unit meets the requirements for a high power weapon which can be employed against naval targets or used in land warfare against stationary targets. In using this unit against land targets no special preparation is essential in providing a foundation. It is halted on the railway track pointing in the general direction of the target. By moving the top carriage upon the girders a traverse of seven degrees may be obtained which permits of accurately getting on the target. In going into position for firing on land targets the only preparations necessary are the lowering of two out-riggers on the side to prevent rolling along the track and the elevation of the gun from its traveling position into its firing position by a hydraulic jack. The provision for a traveling position and a firing position of the gun in this unit permits it to negotiate railroad clearances otherwise impossible. In addition to increasing the number of railroads that the unit may go over this provision of a traveling and firing position of the gun also eliminates the necessity of digging a pit in the track to allow for the recoil of the gun.

For firing against naval craft this unit is run over a concrete block set in the railroad track. There is provided under the lower side of the girders a pintle that is lowered down onto the concrete block where it

rests on large ball bearings. After the mount is balanced on the pintle the trucks are removed. In this manner a traverse of 360 degrees is obtained. In order to provide for the whipping action set up in the girders when the unit is fired a steel ring is emplaced so as to take up this action through the means of adjustable jacks.

In order to aid in obtaining rapidity of fire, electric power elevating and traversing systems have been installed. The loading will be done by gravity. A breech block and a gas ejector system in every way similar to the type installed in the 16-inch barbette gun previously described, is used. The unit will be self contained as there is installed and made a part of it a gasoline electric generating set. A rate of fire of one shot in 40 seconds will be obtained.

The 14-inch railway mount is so designed that it can be used as a mount for the 16-inch 25 calibre howitzer. No modifications are necessary in the carriage. The 14-inch gun and cradle is lifted out of the trunnion seats and the 16-inch howitzer and cradle as now mounted on the barbette carriage, replace it, without any changes or alterations. In this way there is provided a mobile railway unit of the same power as the fixed mount.

It is interesting to study the characteristics of the 14-inch railway unit and see what are some of its principal capabilities. The following are enumerated:

(a) *Mobility.* No doubt the most outstanding development is the one of making mobile a weapon of the power of the 14-inch 50 calibre gun. This unit can be moved as part of a train across the United States by a number of routes. It can reach the important coastal areas and supply any need for long range high power guns for defense against naval attacks.

(b) *Capable of rapid installation.* It should be possible with proper personnel to install this unit in two hours.

(c) *Elevation and traverse.* A traverse of 360 degrees is provided as well as sufficient elevation to permit of the obtaining of the full power of the cannon.

(d) *Rate of fire.* It has a rate of fire equal to any type of barbette gun now installed, or contemplated for future installation.

(e) *Capable of accompanying field army.* Due to type of construction and special characteristics it can accompany an army in the field and perform all missions assigned in the past to such types of artillery.

The original building program for 14-inch guns that were to be used in France has been given in the previous discussion. The Armistice found this program under way to such an extent that approval was given for the completion of 42 of these guns. Having guns of this power on hand the next queston was how could they best be used in improving the power of land artillery, to offset the great advances in naval artillery.

COMPARATIVE CHARACTERISTICS OF ARMAMENT

	M. V., f. s.	Weight of projectile	Range at 45° elevation yards	Remaining velocity at impact, f. s.	Angle of Degress, Fall	Perforation of Deck Armor, Inches	Perforation of Side Armor Plate at 15,000 yards range, inches	Perforation of Belt Armor at 20,000 yards range, inches	Life of Piece in Rds.	3/4 Max. Muzzle Velocity, f. s.	Range at 45° elevation yards	Remaining Velocity at Impact, f. s.	Angle of Degrees, Fall	Perforation of Deck Armor, Inches	Life of Piece in Rds.
TYPES IN SERVICE															
12-inch Gun, Model 1895....	2250	1046	30,000	1350	59° 50′	11.	8.74	7.2	490	1700	19,000	1238	54½°	9.3	2,000
12-inch Gun, Model 1900....	2250	1046	30,000	1350	59° 50′	11.	8.74	7.2	490	1700	19,000	1238	54½°	9.3	2,000
12-inch, Model 1918.....	2650	1046	39,400	1430	63°	12.	10.7	8.5	350	2000	25,000	1300	58°	10.25	1,400
12-inch Mortar, Model 1912.	1800	700	19,300	1240	53°	7.6	....	....	1600	1350	12,500	1100	49°	5.8	6,400
14-inch Gun, Model 1907....	2150	1660	30,500	1390	58½°	13.	9.5	8.4	380	1600	19,000	1235	53°	11.6	1,500
14-inch Gun, Model 1910....	2350	1660	35,600	1450	60°	14.1	10.8	8.8	320	1750	22,000	1280	54½°	12.3	1,300
TYPES BUILDING															
14-inch Gun, Model 1920 ...	2600	1660	42,700	1500	62°	15.2	12.6	10.	240	1950	26,200	1310	55½°	12.9	1,000
16-inch Gun, 50 Calibers....	2700	2400	47,500	1560	62½°	18.	14.9	11.5	180	2000	29,800	1370	57°	16.7	750
16-inch How., 25 Calibers...	1800	2400	26,800	1300	55½°	13.	....	....	900	1350	15,400	1145	50°	12.0	3,600
TYPES POSSIBLE															
18-inch Gun, Mark I, 50 Cals	2950	3000	56,800	1600	65°	24.	18.2	16.3	120	2200	24,000	1430	58½°	20.1	500
16-inch Gun—60 Calibers...	3250	2400	64,700	1620	65° 50′	22.	19.6	14.2	126	2450	40,500	1535	60½°	20.3	500

The following table taken from published hearings of the Fortification Appropriation Bill Committee by the Chief of Coast Artillery is interesting:

	12 inch D. C.	*12 inch B. C.*	*14 inch*	*16 inch*
Length in calibres	40	35	50	50
Weight of projectile, pounds	1,070	1,070	1,660	2,400
Muzzle velocity, f. s.	2,250	2,250	2,600	2,700
Muzzle energy, ft. tons	36,754	36,754	73,920	121,430
Maximum elevation, degrees	15	35	50	65
Maximum range, yards	17,300	26,800	41,570	44,850
Maximum range, miles	9.8	15.2	23.6	25.5

The above capabilities of the 14-inch railway mount in connection with the number of guns on hand has caused Congress to appropriate funds for units of this type. Of the ships that will be retained by the United States, England, Japan, France and Italy, as fixed by the Conference on the Limitation of Armaments, it appears that only about five will be armed with 16-inch guns. Due to slow rate of rehabilitating land artillery it is apparent that every effort should be made to so build as to be at least two decades ahead of naval artillery. The table showing the comparative characteristics of certain old and new armament as well as possible types is interesting.

THE ADVANTAGES GAINED FROM ZONING DIRECT FIRE LAND ARTILLERY

A study of modern ship construction shows that the deck protection has been materially increased. This protection, it is understood, will amount to as much as seven or more inches in foreign navies. A study of Figures 10 and 11 indicate that at ranges beyond approximately 24,000 yards for the 16-inch gun and 18,000 yards for the 14-inch gun, 14 inches of armor cannot be penetrated at normal impact. From Figures 10, 11 and 12 it will be seen that at the above ranges the angle of fall is approximately 25°. This angle is the maximum angle at which modern armor piercing projectiles have penetrated armor plate on acceptance tests. Having in mind the difficulties of penetrating belt armor and the likelihood of failure of the projectile to bite on the deck armor the employment of these guns as direct fire weapons from 24,000 to 32,000 yards for the 16-inch and 18,000 to 28,000 yards for the 14-inch becomes very questionable. A consideration of Figures 8 and 9 show that at ranges beyond 22,000 yards for the 16-inch and 21,000 yards for the 14-inch the greater percentage of hits on the ship will be on the deck.

The question, therefore arises, as to the best way to attack the target within the ranges pointed out. The relative effectiveness of high angle fire hits and direct fire hits at once points to the necessity of using high angle fire. This principle is old and unquestioned, but the securing

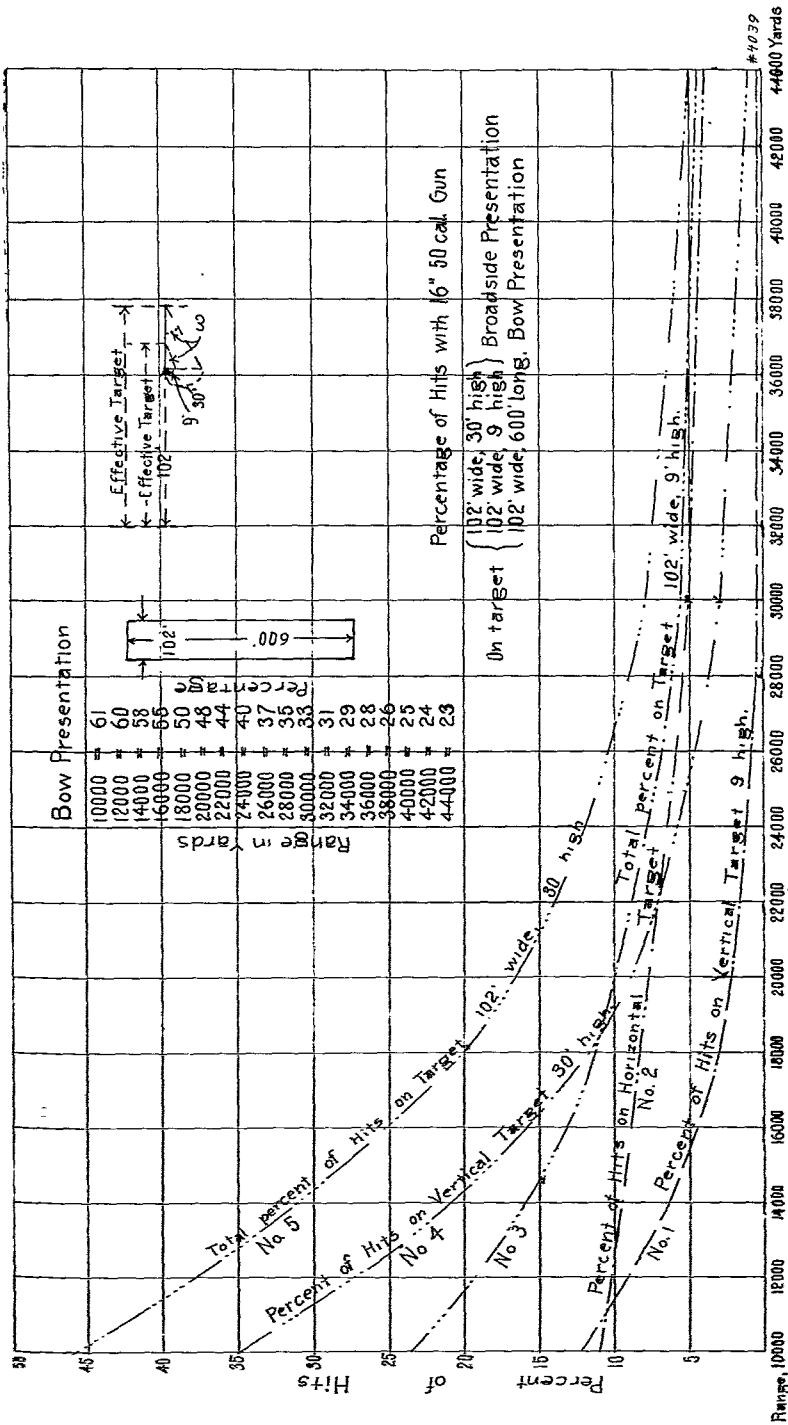

Bow Presentation
Range in Yards
Percentage
10000 = 61
12000 = 60
14000 = 58
16000 = 55
18000 = 50
20000 = 48
22000 = 44
24000 = 40
26000 = 37
28000 = 35
30000 = 33
32000 = 31
34000 = 29
36000 = 28
38000 = 26
40000 = 25
42000 = 24
44000 = 23
Effective Target
Effective Target
102'
.009
Percentage of Hits with 16" 50 cal. Gun
On target
102' wide, 30' high
102' wide, 9' high
Broadside Presentation
102' wide, 600' long, Bow Presentation
Total percent of Hits on Target
No 5
Percent of Hits on Vertical Target 102' wide
No 4
No 3
30' high
Total percent on Target
102' wide, 9' high.
Percent of Hits on Horizontal Target
No 2
Percent of Hits on Vertical Target 9' high.
No 1
Percent of Hits
Range, 10000
12000
14000
16000
18000
20000
22000
24000
26000
28000
30000
32000
34000
36000
38000
40000
42000
44000 Yards
#1039

FIG. 8.

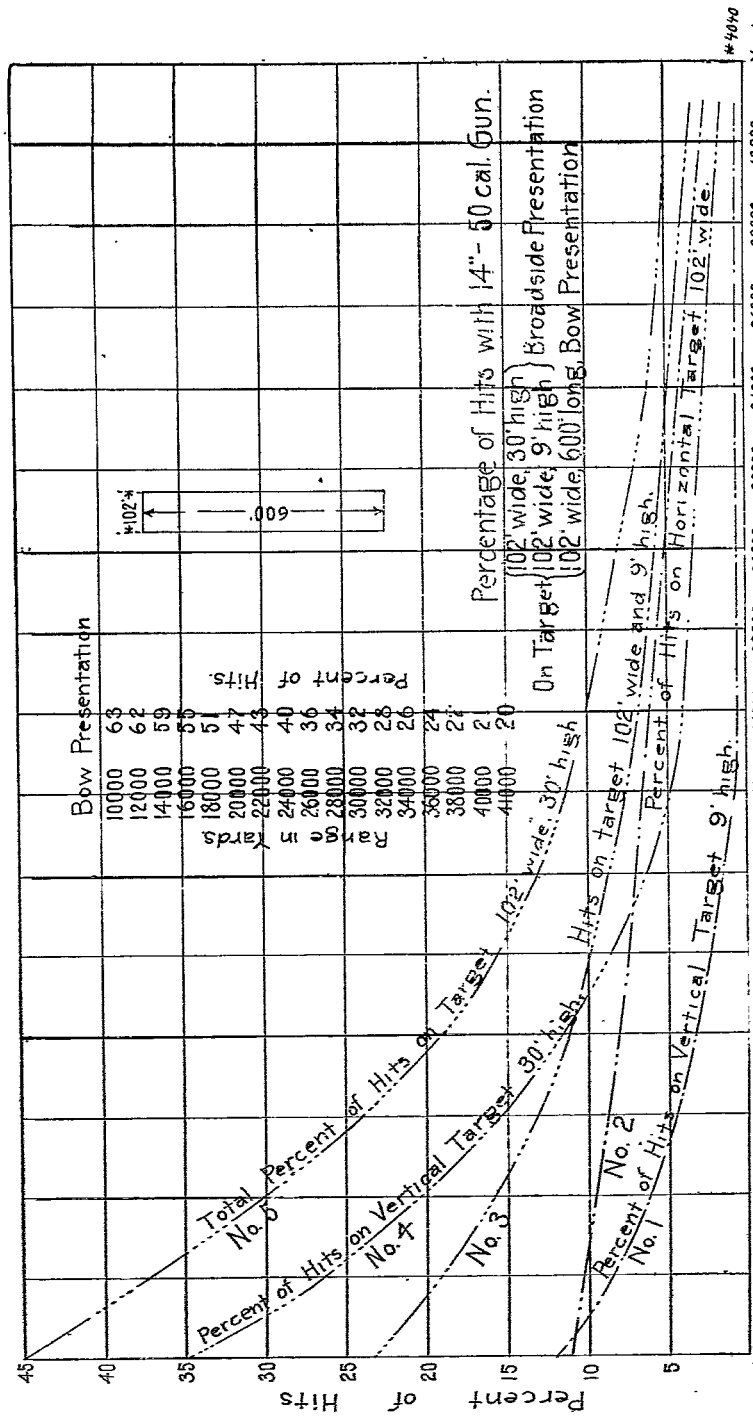

Percentage of Hits with 14"- 50 cal. Gun.
On Target { 102' wide, 30' high } Broadside Presentation
{ 102' wide, 9' high }
102' wide, 600' long, Bow Presentation
Bow Presentation
Range in Yards
Percent of Hits
10000 63
12000 62
14000 59
16000 55
18000 51
20000 47
22000 43
24000 40
26000 36
28000 34
30000 32
32000 28
34000 26
36000 24
38000 22
40000 21
44000 20
102'
600'
Total Percent or Hits on Target 102' wide, 30' high
No. 5
Percent of Hits on Vertical Target 30' high
No. 4
No. 3
Hits on Target 102' wide and 9' high.
Percent of Hits on Horizontal Target 102' wide.
No. 2
No. 1
Percent of Hits on Vertical Target 9' high.
Percent of Hits
Range 10000 12000 14000 16000 18000 20000 22000 24000 26000 28000 30000 32000 34000 36000 38000 40000
Yards
45 40 35 30 25 20 15 10 5

FIG. 9.

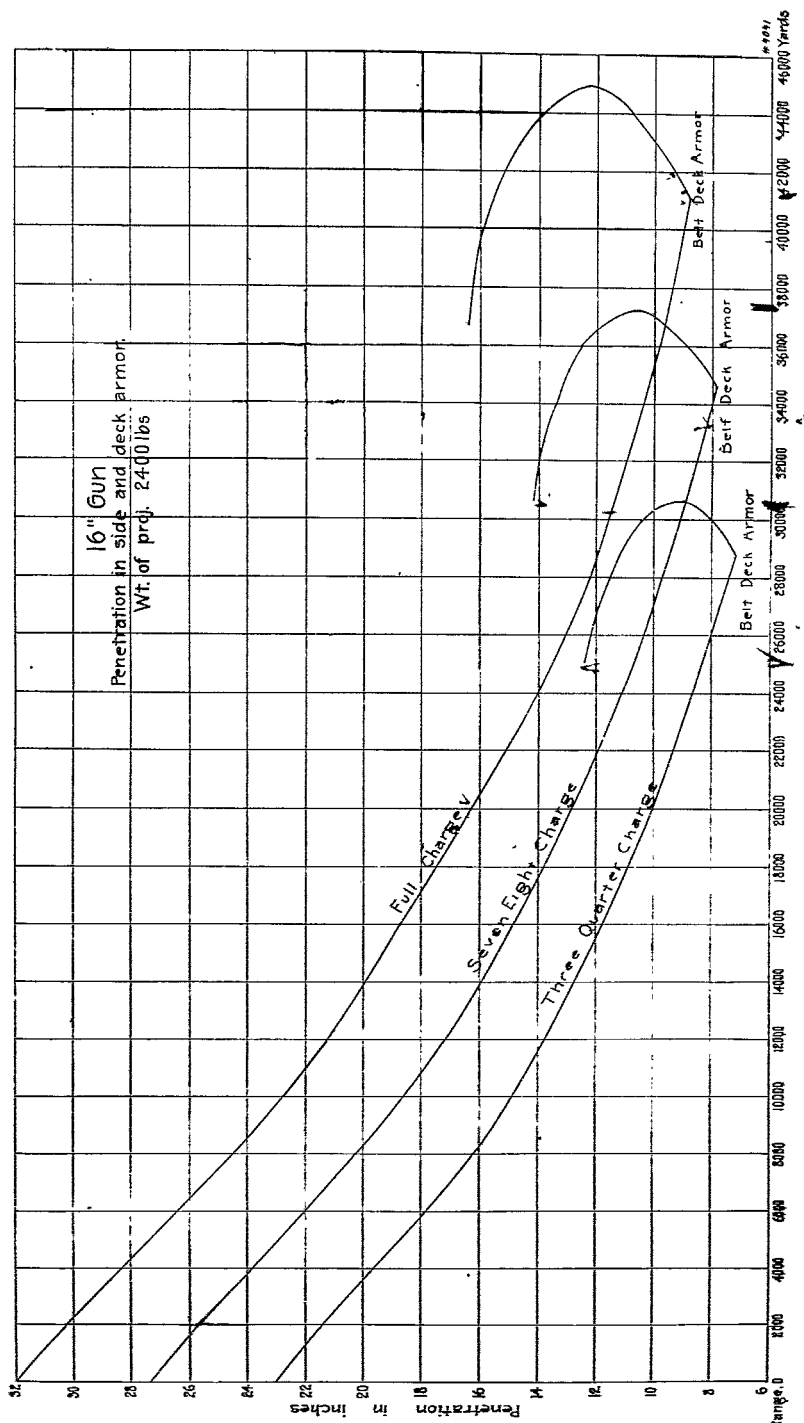

16" Gun
Penetration in side and deck armor
Wt. of prj. 2400 lbs
Full Charge
Seven Eighth Charge
Three Quarter Charge
Belt
Deck Armor
Belt
Deck Armor
Belt
Deck Armor
Penetration in inches
Range in Yards

Fig. 10.

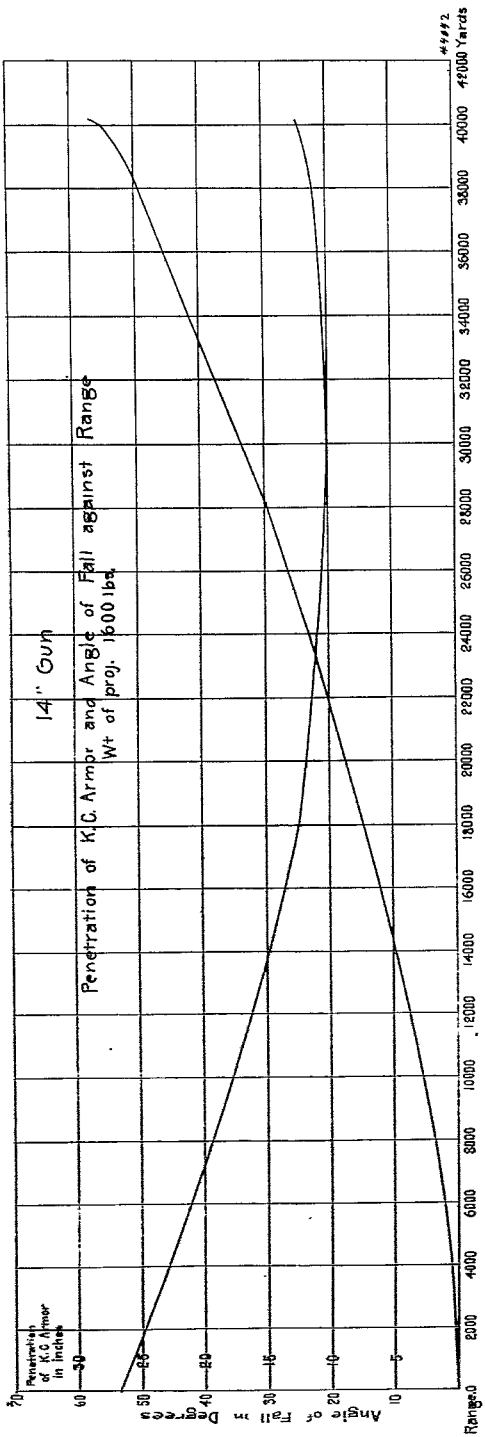

14" Gun
Penetration of K.C. Armor and Angle of Fall against Range
Wt of proj. 1600 lbs.
Penetration of K.C. Armor in Inches
Angle of Fall in Degrees
Range Yards
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
28000
30000
32000
34000
36000
38000
40000
42000

Fig. 11.

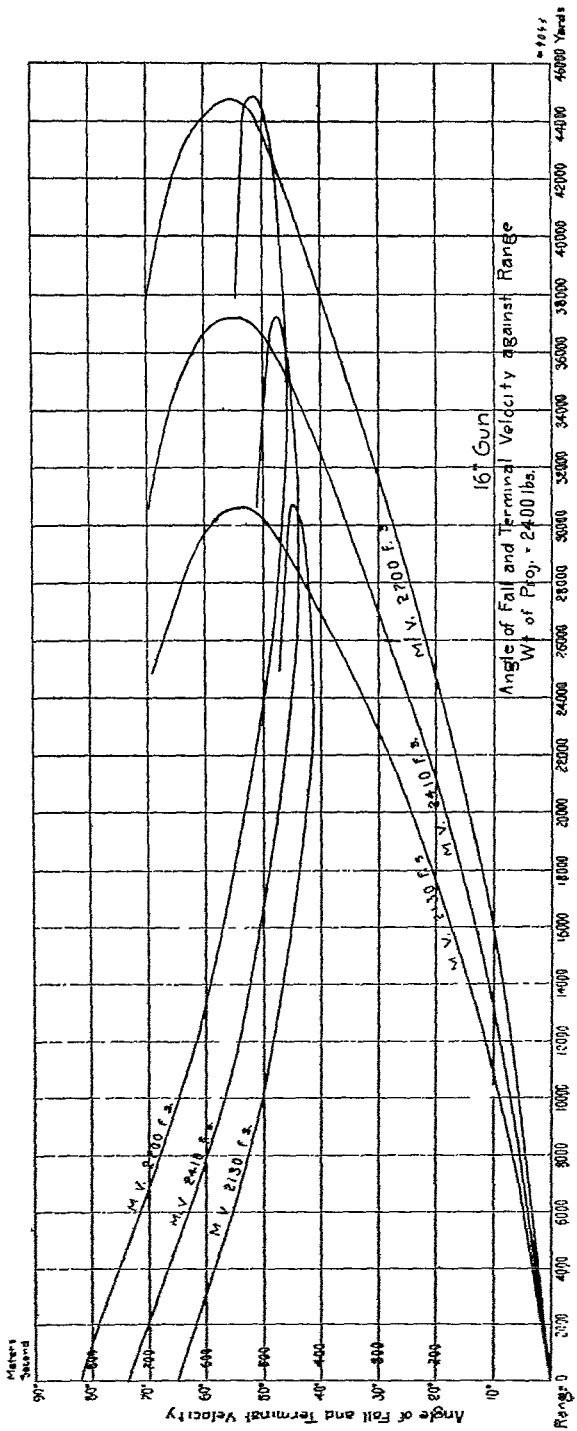

16" Gun
Angle of Fall and Terminal Velocity against Range
Wt of Proj. - 2400 lbs.
M.V. 2700 f.s.
M.V. 2410 f.s.
M.V. 2130 f.s.
Angle of Fall and Terminal Velocity
Range

FIG. 12.

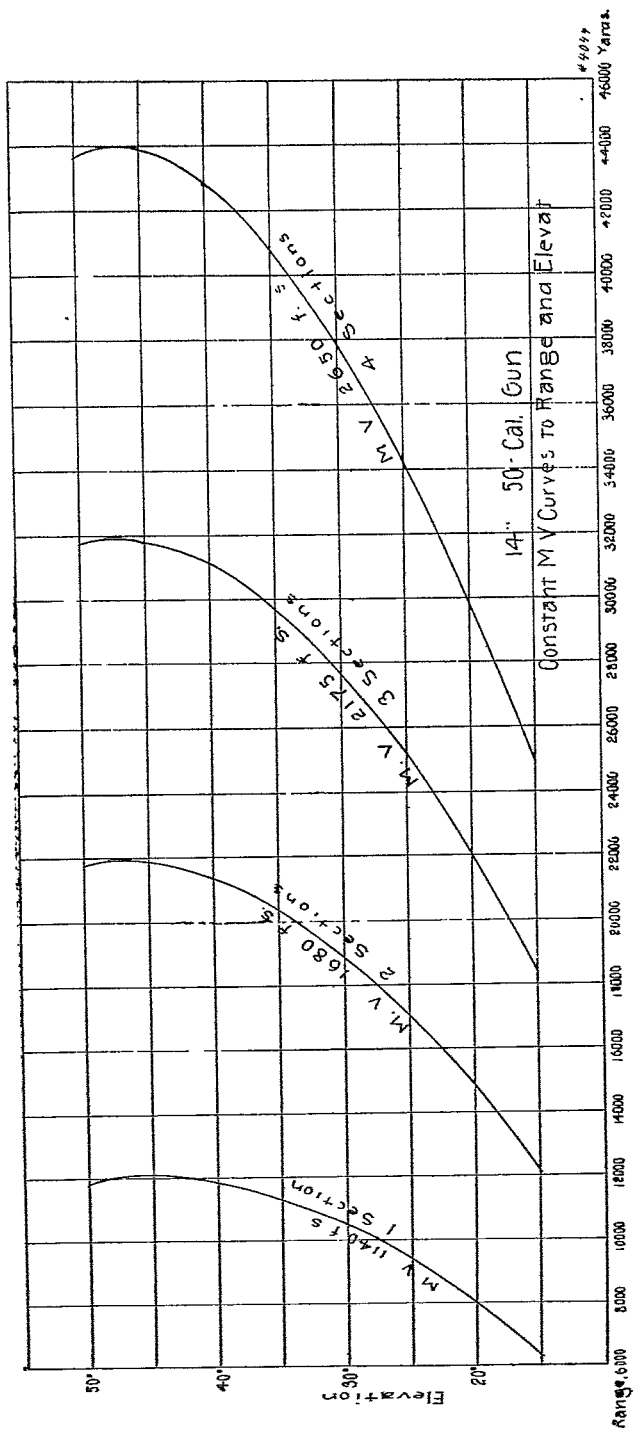

Constant M V Curves to Range and Elevat
14" 50-Cal. Gun
M V 2650 f.s
M V 2175 f.s
M V 1680 f.s
M V 1140 f.s
Elevation
Range, Yards
50°
40°
30°
20°

Fig. 13.

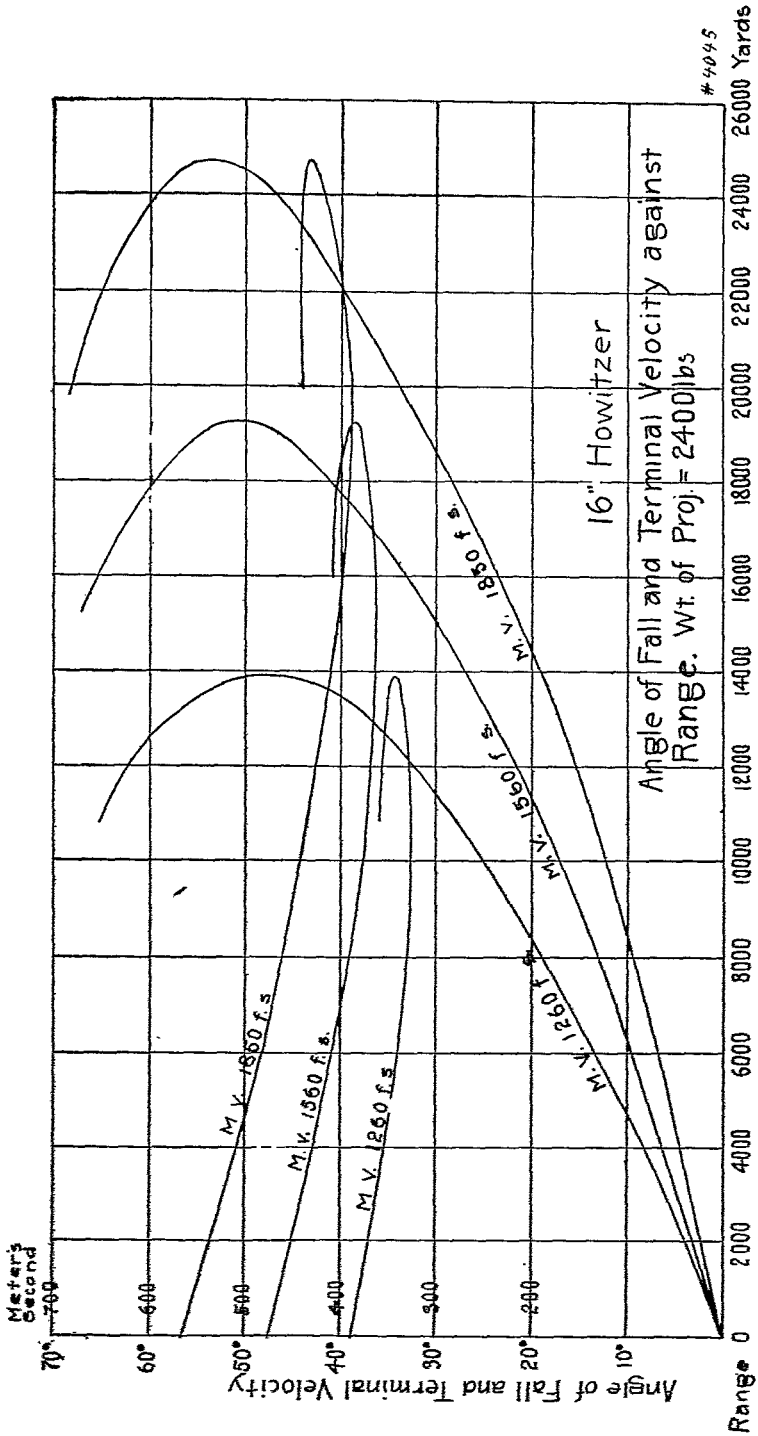

16" Howitzer
Angle of Fall and Terminal Velocity against Range. Wt. of Proj. = 2400 lbs
#4045
M.V. 1860 f.s.
M.V. 1660 f.s.
M.V. 1460 f.s.
M.V. 1260 f.s.
M.V. 1060 f.s.
Angle of Fall and Terminal Velocity
Meters Second
Range 0 2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 22000 24000 26000 Yards
10° 20° 30° 40° 50° 60° 70°
200 300 400 500 600 700

Fig. 14

of high angle fire with primary gun armament has not been possible in the past. The new types are so built as to permit of the utilization of high angle fire for the attack of capital ships. This is accomplished by zoning the guns. Figures 12, 13 and 14 illustrate how by the employment of reduced charges or zones it will be possible to obtain at all ranges effective fire. In the outer limits of the fire of the 16-inch and 14-inch guns the effect of the fire is high angle as the angle of fall is great enough to secure deck penetration in all cases. In all cases where the range will permit, the employment of zone charges will give increased accuracy life to the gun due to the use of reduced muzzle velocities.

In concluding it is desired to point out that from 1888 to 1917 no radical departures from the original designs and types of land artillery have been made. We find that the calibres employed in quantity have not materially changed during this period. The laying down of new requirements after the World War and the incorporation in the new designs of the information gained from abroad as well as that resulting from building activities in this country, now brings the general types of land artillery as well as the details thereof, up to the highest stage of development. This now places land artillery several decades in advance of naval armament.

Cotangent Method of Anti-Aircraft Searchlight Control

By Captains Dale D. Hinman and Maurice Morgan, C. A. C.

IN any method of fire control depending upon sound listening apparatus the consideration of mobility necessitates the assumption that only one sound listening apparatus will be used, the disadvantages of the two-station method being readily apparent to all Artillerymen familiar with Anti-Aircraft Artillery. It is well-nigh impossible at night when several targets are in the air to be certain that your various observers are reading upon the same target. Moreover the time required to emplace two listening apparatus stations, orient the base line and install necessary lines of communication would often make this system undesirable if not impossible to employ, in the front areas. With the Cotangent Method, using only one station and that located at the pilot light, these various disadvantages are eliminated.

In the following discussion it is assumed that both the listening apparatus and the pilot light have been emplaced in positions whose map coordinates have been accurately determined and that both have been carefully oriented on true north by means of their respective azimuth circles. It is further assumed that the listening apparatus is located in close proximity to the pilot light, thereby doing away with any correction for displacement of light and listening apparatus. The plotting board requires only four (4) elements of data to operate:

1. Angle of Site of target
2. Azimuth of target

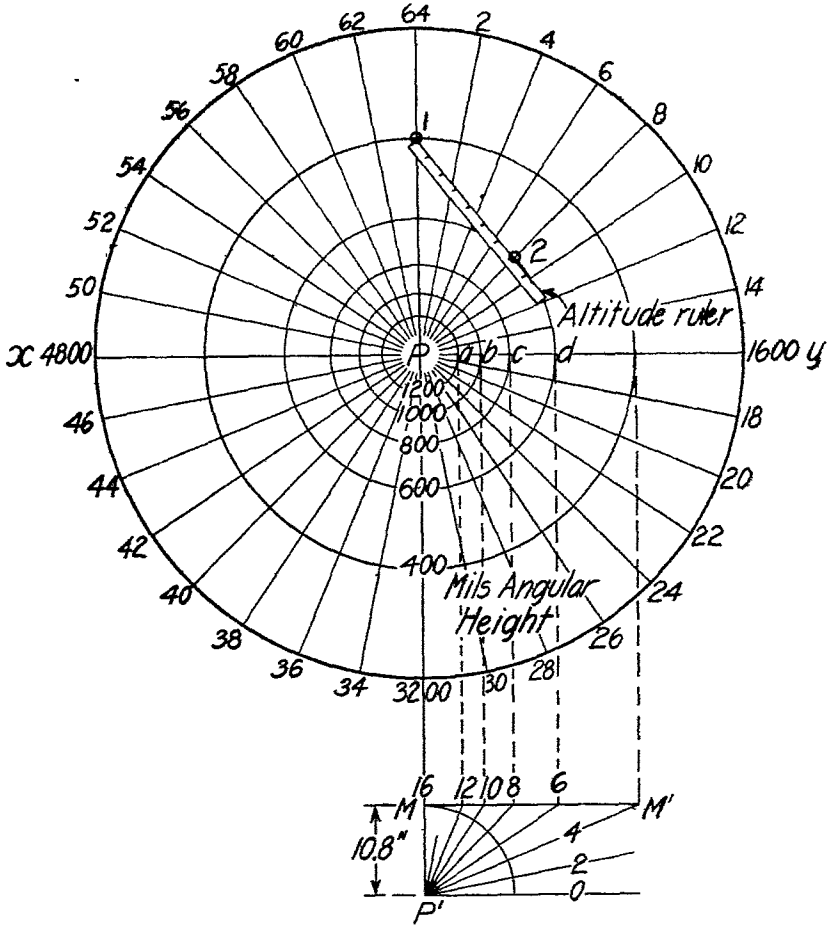
—read from the listening apparatus.

3. Wind direction
4. Wind speed

—obtained from the meteorological station.

From the plotting board we find the azimuth and angular height at which to set the pilot light in order to illuminate the target. The target, having been located in the beam of the pilot light, will be followed by the pilot light until the operators of two or more lights of the section have trained their beams upon the target. This being accomplished, the pilot light will be put out of action.

Note: Due to the advanced position of the pilot light, it should not be continued in operation longer than absolute necessity requires.



Graphic Method of Constructing Cotangent Chart

h_o = 3000 yds. R.F. = 1/10000

Drawing not to scale.

Distance P'M = 10.8" (the map distance) = 3000 yds. to R.F of map. Where angular heights on protractor scale intersect line MM', points are projected vertically to line xy passing through Observer position, distances Pa, Pb, Pc, Pd, etc, are used as radii of circles shown. 4487

FIG. 1.

The target being illuminated by means of two or more lights of the section, the fire control system of the guns will function in a similar manner to that employed in day firing.

Any point in space can be definitely located if the altitude, angle of site and azimuth are known. Once a point is so located, its projection upon the earth's surface is also known, for, knowing the altitude and site, the horizontal range may be found from the equation

Horizontal Range = h cot S

when h is the altitude and S the angular height. The point may then be readily located in a horizontal plane by the polar coordinates θ and Δ, where θ, (theta) = Azimuth and Δ, (delta) = Horizontal Range.

If the altitude remain constant the horizontal range is a function of S only, or $\Delta = K \cot S$.

A map can be taken, drawn to a definite scale, upon which the position of the observing station can be accurately located and the cotangent chart drawn about this point as a center. (Figure 1.) The cotangent chart can be constructed either graphically or by employing values derived from the formula h cot S, h being constant and S varying depending upon the angular height; example S = 1600, 1200, 1000, 800, 600, etc., mils.

Graphical Method Of Construction Of Cotangent Chart

In the graphical construction of the cotangent chart shown in Figure 1 we assumed that our value for h would be 3000 yards, or the altitude at which we expect night bombers to pass over our lines. The R. F. of our map taken as $\frac{1}{10{,}000}$, 3000 yards in inches to the R. F. of our map $= \frac{3000 \times 3 \times 12}{10{,}000} = 10.8$ inches. This dimension is laid off as the vertical distance between two horizontal lines at the bottom of the map and a mil protractor is so placed that its center is upon the lower horizontal line and immediately below the position of the observing station as plotted upon the map. At the points where the protractor mil angles (0-1600) intersect the upper horizontal line we project lines upward perpendicular to and intersecting a horizontal (East and West) line passing through the plotted position of the observation station. Using the distances from P (the plotted position of observing station) to respective points of intersection as radii, we describe concentric circles with P as a center and we will have circles of varying angular height all for an altitude of 3000 yards. (Figure 1)

Mathematical Construction Of Cotangent Chart

The cotangent chart can be mathematically constructed by using values obtained from solution of formula, $\Delta = h \cot S$, for varying values of S and using the distances so obtained as radii of circles to be

drawn about the observing station as a center. (Figure 2.) The chart shown is plotted for an altitude of 3000 yards and a map scale of $\frac{1}{10,000}$.

Two positions of the target are shown in Figure 1; one for an angle of site of 400 mils and an azimuth of 0 mils, the other for an angle of

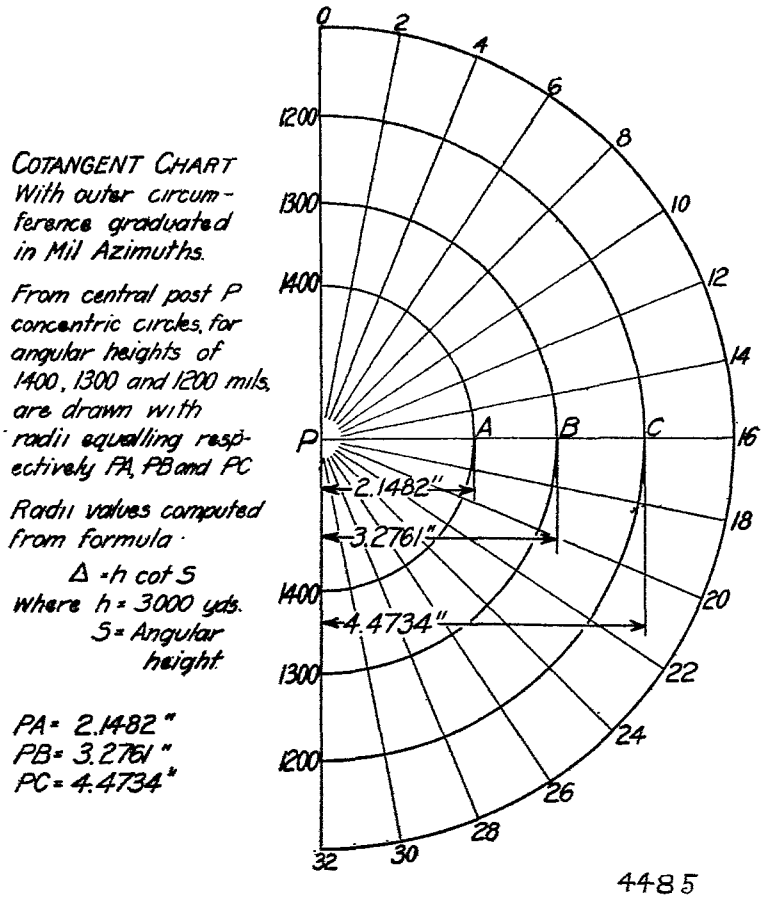


FIG. 2.

site of 600 mils and an azimuth of 800 mils, the target being at an altitude of 3000 yards. The distance between the two points is measured and found to be 3875 yards.

The path of an aeroplane can be plotted on such a chart and if the plane flies at an altitude of 3000 yards, the trace on the chart will follow the projection of the actual path of the target. If the chart has been constructed of tracing linen or tracing paper and is superimposed over a battle map the position of the plane relative to all important points

such as villages, ammunition dumps, headquarters, etc., can be readily determined. The course of a plane flying at any altitude other than 3000 yards may be plotted on this same chart. Distances plotted on the chart will then vary inversely as the altitude of the target. Thus a change in altitude means merely a change in map scale, and if a constant actual distance covered is plotted upon the cotangent chart the map distance of the plot will vary inversely as the altitude of the target. Assuming a target speed of 50 yards per second (this will vary depending upon the types of planes tracked) and an observing interval of 30 seconds, the target will fly 1500 yards; if the path of the target is plotted on the chart for a like period, the map distance of the resultant plot will vary inversely as the altitude of the target tracked. Thus, for a target whose altitude was 3000 yards the map distance plotted would be 1500, and for a target whose altitude was 1500 yards the plotted distance would be 3000. If then the path of the target be tracked for

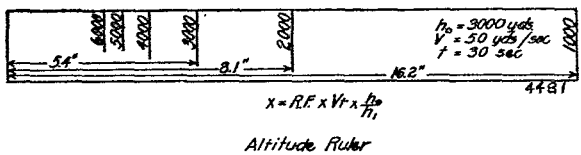


FIG. 3.

30 seconds and the observed angular heights and azimuths obtained from listening apparatus are plotted, we may determine the altitude by measuring the map length of plotted path.

ALTITUDE SCALE. (FIG. 3)

The altitude scale used for such measurement is constructed as follows, assuming the data given below:

Engine Speed = 50 Yards per second
Observing Interval = 30 seconds
Altitude of cotangent chart with which ruler is to be used = 3000 Yards.

Make a table as follows, using the equation,

$$X = R.F. \times Vt \times \frac{h_0}{h_1}$$

where h_0 = 3000 yards (the altitude for which the cotangent chart has been made.

h_1 = varying altitudes from 1000 to 6000 yards (i.e. any other altitude)

$RF = \frac{1}{10{,}000}$

X = distance in yards from 0 point of altitude scale to the graduation corresponding to the particular value of h_1 used.

To facilitate construction the values of X are multiplied by 36 thus giving the resultant answer in inches.

Example:

For $h_0 = 3000$, $h_1 = 1000$

$$X = \frac{1}{10{,}000} \times 50 \times 30 \times \frac{3000}{1000} \times 36$$

$$X = 16.2 \text{ Inches.}$$

By a similar process and substituting appropriate values of h_1 we derive the following table

$h_1 = 1000$	2000	3000	4000	5000
$X = 16.2''$	8.1″	5.4″	4.05″	3.24″

The various values for X are measured off to actual scale on altitude ruler, and at the points so determined the corresponding altitudes, h_1, are marked. (See Figure 3.) In so much as cotangent charts for various altitudes may be constructed, we must necessarily construct

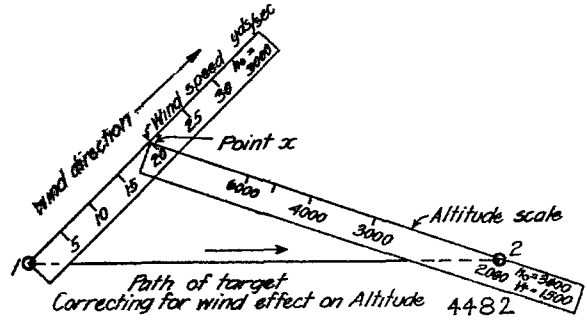


FIG. 4.

altitude scales for use thereon those h_0 values are identical with the altitudes used in constructing the cotangent charts.

If two positions of the target are now plotted on the cotangent chart separated by a time interval of 30 seconds and the distance between the two points measured by the altitude scale, the altitude can be found.

Practical Operation of Altitude Scale

Place the arrow of your altitude scale on your first plotted point on cotangent chart and align your scale from your first plotted point (1) to your second plotted point (2) and opposite the point marked (2) read your altitude. (Figure 1.)

CORRECTION FOR WIND EFFECT

Wind at the altitudes usual for night raids can reduce or increase true engine speed of target by one half and therefore some correction must be applied to the distance between points (1) and (2) in order that proper altitudes may be read therefrom. Tail winds give increased

engine speeds while head winds give decreased engine speeds. Since the altitude is obtained on the assumption of a known engine speed, if we do not correct for wind effect we will read a false altitude. The actual travel of our target may be either increased or decreased depending upon the direction and intensity of the wind. Our altitude rulers are constructed for a true engine speed and since our altitude is determined by the distance between two plotted points, it will be erroneous if the travel of the target has any value other than that of true engine speed. The wind correction scale corrects for wind effect and is used as follows:

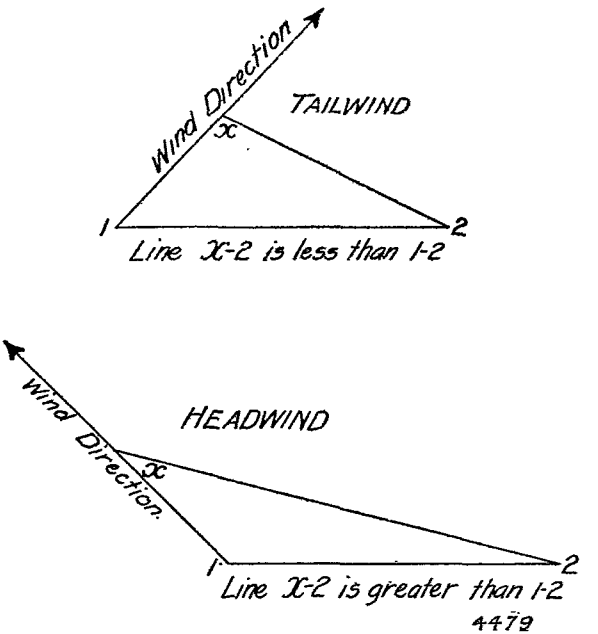


FIG. 4A.

(See Figure 4.) Point (1) is the first plotted point on the cotangent chart and (2) is the second plotted point. Place the index of the wind ruler on the point (1) and extend the ruler in the direction the wind is blowing always remembering that a head wind should give a vector X—2 greater than vector 1—2, and a tail wind should give a vector X—2 less than vector 1—2. At a point X (corresponding to the wind speed (W), in yards per second, place the arrow of the altitude ruler and extend the ruler through point 2. Read the altitude from the altitude scale opposite point 2. This is distance X—2 on the diagram.

CONSTRUCTION OF WIND RULER (FIGURE 5.)

Wind speed rulers are made for altitudes of every 500 yards using the formula

$$Y = \frac{W\,T\,C}{h_1}$$

where

W = wind speed in yards per second.

T = Time (30 seconds or length of observing interval)

C = R. F. $\times h_0$

h_1 = 2500, 3000, 3500, 4000 (i.e., for altitudes varying by 500 yds).

A wind scale has been constructed (Figure 5.) for 3000 yards altitude (i.e., $h_1 = 3000$) for wind speeds from 0 to 30 yards per second.

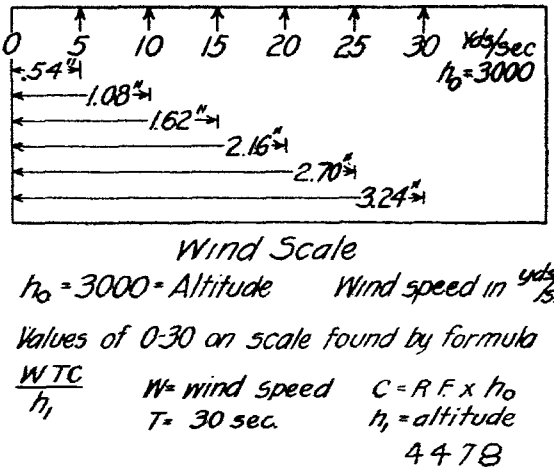


FIG. 5.

Example:

W = 5 yards per sec.
T = 30 seconds
h_1 = 3000 Yards.
h_0 = 3000 Yards (Alt. of Cot. chart)
$C = \frac{1}{10{,}000}$

Substitute in formula $Y = \frac{W\,T\,C}{h_1}$

$$\frac{5 \times 30 \times \frac{1}{10{,}000} \times 3000 \times 36}{3000}$$ (to reduce to inches)

Y = .54 inches (Distance on ruler)

By similar process we derive the following table:

W =	10	20	30 (Yds. per sec.)
Y =	1.08"	2.16"	3.24"

In using the wind speed ruler it is necessary that the wind ruler used be constructed for an h′ value identical with the altitude for which the target is expected or estimated to be; h_0 of wind speed ruler is of the same value as the value used for altitude in constructing cotangent chart. The true altitude of the target having been obtained, we track the target as shown in Figure 6, a_1, a_2, a_3, a_4, a_5, a_6, a_7 and a_8 being points plotted by means of the azimuth and angle of site read from the listening apparatus. It is not necessary to use a fixed interval between observations,

once the true altitude has been determined. However, in Figure 6, the intervals between readings were taken as being 30 seconds. The target having arrived at a point within range of our guns and lights, it

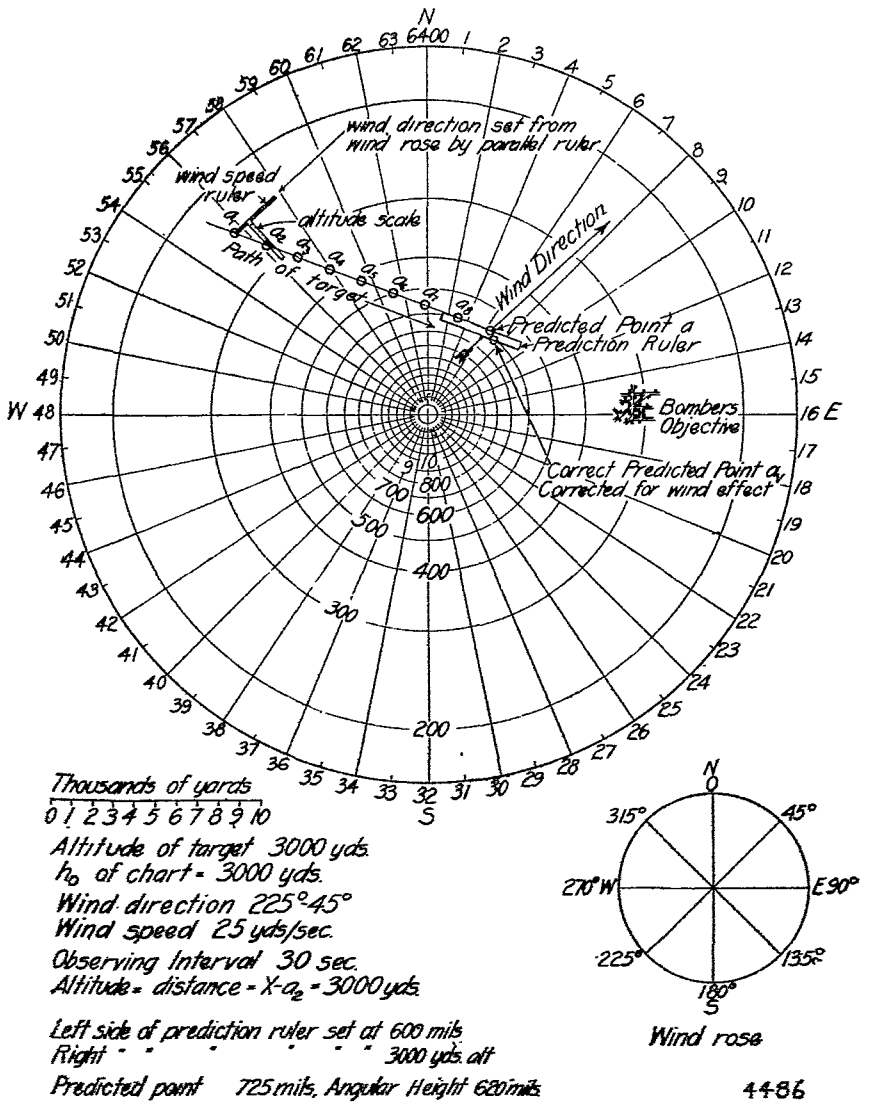


FIG. 6.

is necessary to find the set-forward point in order that we may send the azimuth and angle of site of that point to the pilot light to enable it to illuminate the target. To accomplish this a prediction ruler is required.

Prediction Ruler

The prediction ruler is shown in Figure 7. In constructing the prediction ruler two factors must be taken into consideration; first, the *dead time of maneuver* (the time required for the plotting section to function, time required to transmit data and time required for the light to be laid in azimuth and angular height;) second, the time required for sound to travel from the last plotted point to our listening apparatus. This is called *Sound Lag.*

In connection with the dead time of maneuver it is contemplated that the searchlight crew shall have struck the arc and covered same by occulting device and that approximate azimuths and angular heights taken from previous readings will have been applied to the light so that the dead time of maneuver may be reduced to minimum. In using the sound lag to our last plotted position a small error enters into our calculations due to the fact that sound lag to the set forward position will vary slightly from the sound lag of last plotted point, but this error

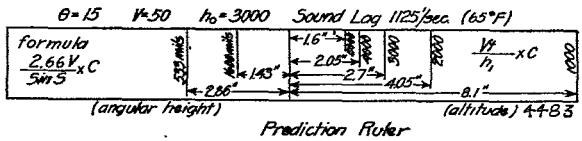


FIG. 7.

will not materially effect the accuracy of our results since it is much less than the minimum error which can be expected from our listening apparatus.

Fifteen seconds is arbitrarily taken as the dead time of maneuver and in the equations discussed below we will call this value t. Sound lag is assumed to be one (1) second for every 1125 feet (65° F.). This value in seconds will depend upon the true distance to the target or, using the cotangent chart method, upon the value of the angular height and altitude of the target. In the equations we shall refer to it as t_s. The distance a_s—a (Figure 6) which is the distance from the last plotted point to the predicted point has a value equal to

$$Z = VT \times R.F. \times \frac{h_0}{h_1}$$

where Z = Distance from last plotted point to predicted point. In the following discussion $Z = a_s - a$.

$T = t + t_s$ or dead time of maneuver + sound lag.

Let V = 50 Yds. per second—(the engine speed taken)
T = 15 seconds + t_s
h_0 = 3000
h_1 = 3000 (in case of the particular problem taken)

Using sound travel of 1125 feet per second, it will require 2.66 seconds for sound to travel 1000 yards.

We have the angular height and azimuth of the last plotted point and with these values known we can determine D, the true distance

$$VT \times R.F. \times \frac{h_0}{h'} = a_s - a$$

$(a_s - a)$ = Distance from last plotted point to the predicted point.

$$R.F. = \frac{1}{10{,}000}$$

h_0 = range in thousands of yards

h_1 = range in thousands of yards.

$$C = R.F. \times h_0 = \frac{1}{10{,}000} \times 3.$$

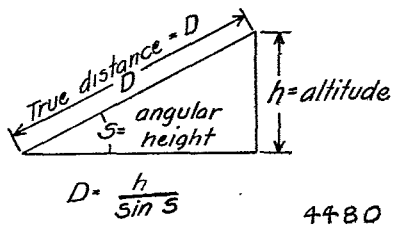


FIG. 8.

$$a_s - a = (2.66\,D + 15)\,V \times R.F. \times \frac{h_0}{h_1}$$

$$= \frac{(2.66\,V\,D + 15\,V)\,C}{h_1} \text{ and } D = \frac{h}{\text{Sin } S}.$$

when D = Range in 1000 yards.

Substitute D value in above equations and it equals

$$\left(\frac{2.66\,V \times h}{\text{Sin } S \times h_1} + \frac{15\,V}{h_1}\right) C$$

But $h_1 = h$, the true altitude of the target (in this particular example) therefore the equation reduces to

$$\left(\frac{2.66\,V}{\text{Sin } S} + \frac{15\,V}{h_1}\right) C$$

clearing equation for values of V, h_1 and C, we have for V = 50 yds. / sec., $h_1 = 3000$ and $C = \frac{1}{10{,}000} \times 3$.

$$\left(\frac{133}{\text{Sin } S} + \frac{750}{3}\right)\frac{3}{10{,}000} = \frac{133 \times 3}{\text{Sin } S \times 10{,}000} + \frac{750}{10{,}000}$$

To plot we must reduce the equation to inches:

$$\frac{133 \times 3 \times 36}{\text{Sin } S \times 10{,}000} + \frac{750 \times 36}{10{,}000} = \frac{133 \times 3 \times 36}{\text{Sin } S \times 10{,}000} + \frac{27{,}000}{10{,}000}$$

For Sin S = 1600 Mils or 90 degrees, Sin S = 1

$$\frac{133 \times 3 \times 36}{10{,}000} + \frac{27{,}000}{10{,}000} = \frac{14{,}364}{10{,}000} + \frac{27{,}000}{10{,}000} = 1.436'' + 2.7''$$

The predicted point is thus 1.436+2.7 inches or 4.136 inches in advance of the last plotted point, a_8.

If in place of Sin S = 90 degrees or 1600 mils, we substitute values varying from 100 to 1600 mils we can plot various values on the left hand side of our ruler (Figure 7). If in place of $h_1 = 3000$, we do substitute values of h_1 from 1000 to 6000 we will, in a like manner, be able to plot varying travel depending upon altitude, using the right hand side of our ruler.

Practical Operation of Prediction Ruler

Align the ruler along the route of the plane (Figure 6.) and opposite the point marked a_8 place the left side of the ruler at the graduation marked 600 mils (i.e. angular height of a_8). Opposite the true altitude (i.e. 3000) on the right hand side of ruler mark the set forward point. We have thus graphically accounted for the formula V T × R. F. × $\frac{h_0}{h_1}$ or the distance $a_8 - a$.

CORRECTION FOR WIND EFFECT ON SET-FORWARD POINT

The set-forward point, a, being obtained as shown in Figure 6, it then becomes necessary to correct the position of the set-forward point due to wind effect on sound waves and aeroplane. In so far as the element of sound lag is concerned our plotting, up to this point, has been based upon the assumption of sound lag in still air (1125 feet per second at 65 degrees F). No temperature correction has been incorporated since the difference in sound velocity due to this variable is relatively small and our error in neglecting it is much less than the minimum error to be expected from our listening apparatus. However, if we have a wind blowing the sound towards us, its velocity will be materially increased and the point we plot on out cotangent chart will be nearer than the actual position of the target. Conversely, if the wind blows the sound away from us, its velocity will be decreased and the plotted point will be farther than the actual position of the target. In either case our plotted course of the target will be a fictitious one unless an appropriate correction be applied. In Figure 9 we have a wind blowing towards the listener; the actual position of the plane will be at a_v and not at a. In Figure 6 the wind is blowing away from the listener and the true position is at a_v and is nearer to the observer than the plotted track shows. The wind also directly effects the aeroplane and the French Anti-Aircraft Service has adopted the following empirical formula for determining the composite correction to be applied for wind effect on sound waves and aeroplane:

$$\text{Wind effect} = \frac{W\,T\,C}{2\,h_1}$$

Multiplying the equation above and below by V we have

$$\frac{W\,T\,V\,C}{2\,h_1\,V}$$

It has been already shown that the distance $a_8 - a = VT \times \text{R.F.} \times \frac{h_0}{h_1}$

$= \frac{V\,T \times C}{h_1}$: where $C = \text{R. F.} \times h_0$

Therefore Wind Effect $= \frac{W}{2\,V} \times a_8 - a.$

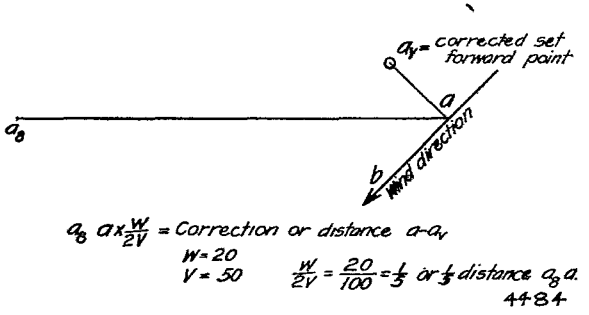


FIG. 9.

In Figure 9, Wind Direction is taken from *Wind Rose* and set through the point a by means of a parallel ruler. Point a_v is taken symmetrical to point b with respect to line $a_8 - a$, using formula $\frac{W}{2\,V} \times a_8 - a$ to determine length of $a - a_v$.

Example:

$$\left.\begin{matrix}\text{Let } W = 25\\ V = 50\end{matrix}\right\} \quad \frac{25}{100} \times a_8 - a = 1/4\ a_8 - a.$$

Lay off on line $a - a_v$ a distance equal to $\frac{1}{4}$ $a_8 - a$ (graphically) and point a_v is the *corrected set-forward point.* The azimuth and angle of site of this point are sent to the searchlight as the point on which to lay the light in order that the plane may be located.

In the employment of the above method of searchlight control it is recommended that cotangent charts be constructed with diameters of 3 or 4 feet and that the circumference of the outer arc be graduated at intervals of 10 mils. A radial arm of suitable length should be pivoted at the central point to facilitate the accurate determination of azimuths to the nearest 5 mils.

During the preparation of this subject the writers have assumed data for successive observing intervals and, employing the principles and formulas above stated, computed mathematically the correct position of

set-forward point a_v. The same data were plotted as accurately as available instruments would permit upon the cotangent chart shown in Figure 6 and the correct position of set-forward point a_v determined graphically by the employment of various scales and devices above mentioned. The resultant error of less than one per cent is not considered excessive and this method of determination, when employed with searchlights whose diameter of beam is between 100 and 120 mils at a range of 5000 Yards should insure illumination of aerial targets.

The authors do not claim great originality for the method of control outlined above and its present form includes many helpful suggestions and ideas volunteered by officers who have interested themselves in the possibilities of such a method. It is offered as one of a number of possible methods of searchlight control and it is believed that, with properly trained observers, it will give results sufficiently accurate to warrant its employment in night firing.

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Deduce from the experience of War, the future of the defence of Coast Fortresses against Attacks by land, sea, and air, during the next ten years.

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"Si Vis Pacem, Para Bellum."

N these days of financial stringency, when the cry for economy is upon the lips of every "man in the street," it is, perhaps, only to be expected that our coast fortresses should be a target for the axe of the economist; the more so, seeing that, during the whole course of the greatest war in the history of Great Britain, there is no single instance of a serious attack by the enemy on any of our great defended ports. The fact that the efficiency of the defences of those ports was, of itself, a reason for the absence of attack, is either unknown to, or deliberately ignored by, those who maintain that coast defences are nothing but a costly encumbrance. And yet these same people would hardly suggest that the Bank of England should be left unguarded, or rest confident in the protection to their houses afforded by locked doors and windows, and therefore vote for the abolition of the Police. That coast defence will be necessary in the future as in the past is beyond doubt. Our problem in this paper is to consider the form which such defence must assume, and in what respects it will differ from the coast defence of pre-war days.

CHAPTER I.

It is to be noted that the period of time to be covered in the forecast in this paper is to be one of ten years. Since the subject was selected, however, two important things have occurred:—

(a) It has been decided by the government that a war against a civilized power may be treated as in the last degree improbable during the next ten years.

(b) At the Washington Conference we have definitely abandoned our position of maritime superiority, and have adopted a "one-power standard", which is to be maintained, again, for a period of ten years.

Consequently we are dealing with a period during which we regard

war as improbable, and when, should the unexpected happen, we shall be relatively weaker than ever before, as regards our navy.

It is to be feared that the opponents of coast defence will be encouraged to even greater activity by the former factor, and will fail to observe that the existence of the latter only renders it more necessary than ever for us to ensure adequate defence for our more important naval bases and sea-ports.

Let us therefore consider for a moment what is the object of a coast fortress, i.e., the rôle it is intended to play in war.

It cannot be doubted that to the uninitiated, the word "Fortress" only too often conveys the same meaning as the word "Fort". It calls to mind an inpregnable citadel such as Kronstadt, or a fortified island fastness such as Heligoland. The expression "Coast Fortress", however, covers an idea far more extensive than this. It is difficult, if not impossible, to give an exact definition, but perhaps a suitable description would be:—"A coast fortress is a locality containing works of defence for the purpose of repelling attack by either air, sea, or land, with the object of safeguarding some important military or civil establishments located within its perimeter". It will be seen that the definition covers every kind of defended locality, from the smallest coaling station up to an enormous area such as that of the Portsmouth Defences, which includes the whole of the Isle of Wight. It will als be apparent that the definition will include not only those localities which exist as coast fortresses in time of peace, whose defences have been gradually developed, extended, or improved in conformity with the progress of scientific and mechanical knowledge, but also localities which may be converted into coast fortresses in time of war. (For examples of the latter we may point to Scapa Flow and Zeebrugge, which were converted into coast fortresses during the recent war, the former as the base for the British Grand Fleet and the latter as an advanced base for German submarines).

As regards the rôle of the coast fortresses, it is merely stating a platitude to say that the only means to final success in war is to attack, and it may therefore be argued that to spend money on a purely defensive article is simply to divert that money from the more profitable purchase of instruments of offence. This is certainly true, within limits. But weapons of attack require renewal and repair, schemes of attack entail provision of food, ammunition, and a host of stores of all descriptions, and finally, the direction of attack calls for the provision of Staffs, Intelligence centres, and numerous establishments of personnel. And all these varying factors demand security as a condition of complete efficiency. The rôle of the coast fortress, therefore, is to provide that security for the direction of attack, and for the preparation, supply, and maintenance of the means thereto, both in personnel and material.

CHAPTER II.

PRE-WAR CONDITIONS

It has always been taken as an axiom that our naval forces would be able to assert superiority at sea over any combination of foreign navies which might be brought against us, and consequently that any movement of hostile fleets on a large scale would be dealt with by our navy within a short time of its commencement. In home waters this period was estimated to be not more than 48 hours. In foreign waters, however, it was clear that no estimate could be made, in view of the scattered nature of our over-sea possessions.

From this followed three main conclusions:—

(a) That an invasion of Great Britain by a large army with all its necessary impedimenta would certainly be impeded, if not actually prevented, by our navy, and that consequently a continuous line of defences round our coasts was not required.

(b) That it was possible, however, that individual ships or squadrons, detached from the enemy's main fleet, might be able to carry out attacks of the "tip and run" nature upon our ports, and that small raiding forces might be landed in undefended localities, and thence attack our fortresses from the land side.

(c) The immunity from attack upon our oversea ports could not be absolutely guaranteed by the Navy.

It is obvious that to make our ports, home and foreign, entirely secure against attack, would have entailed the provision of local defences at each of them, and it is equally obvious that, since our resources, even in pre-war days, were not unlimited, such a course of action could not be adopted. The accepted policy, therefore, was to provide local defence for certain areas which contained important and vulnerable objectives, and to accept the dangers incurred by leaving the less important places undefended. In order to determine the form which such defence should take, it was obviously necessary to consider the nature of attack which might be expected. In view of the probability that hostile forces attacking a defended port would almost certainly be themselves attacked by our naval forces within a few hours, it was decided that, except in a few special cases, it was unnecessary to provide for complete protection against prolonged operations. The important requirement was that the defences should be of such a nature as to act as a powerful deterrent to attack by hostile ships. At certain ports, especially many of those abroad, the minor importance of the port or the improbability of attack by heavy ships made the provision of the full scale of defence required for large fortresses unnecessary, and in other places the special probability of one or other form of attack

called for modification in the means of defence. In fact, the defence of every locality had to be considered on its own merits, with due regard to the importance of the place, its distance from enemy bases, coastal and hydrographical features, etc.

Briefly, the principles on which our schemes of defence were compiled were:—

(a) To keep bombarding ships at such a distance from the fortress, as to prevent serious damage to important targets lying within it.

(b) In the case of home ports, to hold off an attacking enemy until our naval forces should have time to arrive and deal with him by fleet action.

(c) To prevent the entry of torpedo craft into harbours and roadsteads.

(d) To repel attempts at mine-sweeping or the removal of booms or other obstructions, and to prevent the blocking of narrow channels by enemy mine-layers or blockships.

(e) To resist attack from the land-side for a sufficient time to allow of the arrival of our own land forces.

CHAPTER III.

EXAMPLES OF ATTACK AND DEFENCE OF COAST FORTRESSES DURING THE GREAT WAR, AND LESSONS TO BE LEARNT THEREFROM AS TO THE PRINCIPLES OF DEFENCE.

Perhaps one of the most noticable features of the war, in which sea-power played so great a part, and in which the navies of every one of the great naval powers took part, was the paucity of instances of attack on land defences or defended areas by warships. A few of the more noticable are as follows:—

(i). *The Naval bombardment of the Dardanelles.*

This consisted of a deliberate attack by battleships on permanent shore defences, with a view to destroying them so completely as to allow of the entry into the defended waters of craft charged with the duty of removing minefields and other obstacles, and thus to clear a passage into the Sea of Marmora for our fleet, military transports, and various auxiliary craft. The chief lesson to be learnt from this example is that, in a direct duel between ships and forts, the odds are distinctly in favour of the forts. One lucky shot from a ship can, at best, demolish one gun of a fort. On the other hand, one lucky shot from a fort may quite easily neutralize at least half of the guns of a ship. And moreover, owing to the difference in size of the target, and the advantage

accruing from the possession of a fixed and stationary platform, the prospects of accuracy of the land gun are enormously greater than those of the ship's gun. Further, the ship's gun, being designed primarily to engage other ships, and being required to pierce a considerable thickness of armour, is necessarily of very high velocity and therefore of flat trajectory, and employs a very different type of projectile from that which is the most suitable for the attack of land defences. The flat trajectory renders it ill-suited for engaging any but direct-fire targets, and considerations of space prevent the carrying of two classes of projectile.

(ii). *The bombardment of Madras, Whitby, Scarborough, and other open or lightly-defended coast Towns.*

These bombardments, which were all of the "tip and run" nature, only serve to teach us the impossibility of rendering our coasts completely immune from attack. In neither case was there any great military advantage to be secured by the enemy, and in neither case did he inflict on us any damage which could have a real effect on the war as a whole. And, in one or two cases at least, the incidents went to prove the wholesome dread felt by a surface ship of coming within range of even the smallest guns of a coast battery.

(iii). *The German torpedo-boat attack on Dover.*

This attack was entirely half-hearted, and was not pressed home. This was perhaps chiefly because it was made without any very definite object, but was also, no doubt, partly on account of the readiness of the defences.

(iv). *The blocking of Zeebrugge.*

This operation was in every way a model. Its success practically crippled the German submarine campaign, not merely by the loss of the use of the vessels which were shut in, but by the denying to the enemy of his advanced submarine base. It was a triumph of organization and foresight. Every possibility had been considered, every development forecasted, every element of risk eliminated as far as possible. For these reasons it succeeded completely, where every similar attempt in previous history had been either a complete or partial failure.

The operation consisted of several features.—Long-range bombardment of the heavy guns of the defence, short-range bombardment of the light guns, a raid on the land defences by landing-parties, attack on the boom and net defences by small craft, and finally the sinking of three large vessels in the narrow entrance of the canal, inside which was the submarine anchorage.

The chief lesson to be learnt by the defence from this attack, is, we think, the necessity for a high standard of training in the personnel. Two points seem to emerge from the reports of the action above all others, namely:—

(a) The diversion created by the appearance of the "Vindictive" alongside the mole was indeed a diversion. It apparently caused every man of the defence to look westwards, with the result that the blockships coming from the north-east were not engaged until too late.

(b) When the "Vindictive" emerged from the smoke-screen within 100 yards of the mole battery, excitement caused the gunners to fire point-blank at her sides, instead of at her water-line. Consequently no vital damage was done. Had she been riddled on the water-line, she would possibly have been unable to close on the mole, and in any case she (and therefore her landing parties) would never have been able to get away again.

(v). *Attack on shipping at Constantinople by our submarines.*

This operation, although its success had, perhaps, but a small effect on the war, teaches to the defence the useful lesson that, however thick be the mine-fields, and however many the booms or net defences, a determined submarine commander, provided he has sufficient depth of water in which to manoeuvre, may at any time penetrate them, and hence that no material obstacle can be a substitute for vigilance in look-out duties and instant readiness for action on the part of all defence personnel. Here again we see the need for a high standard of training.

CHAPTER IV.

DEVELOPMENTS DURING AND SINCE THE WAR.

The changes in methods and material during the recent war have, indeed, been immense. Perhaps the greatest development, and that which will exercise the largest influence on our future methods, has been the introduction and perfection of a new arm, i.e., the aerial fighting machine. Before we study this new arm, however, it seems advisable to consider what changes have taken place in those we knew formerly. Let us therefore look at the development of the power of attack, i.e., of naval power.

Developments in the attack.

The most striking innovations are:—

(i) *The increased range of guns.* Where, formerly, it was considered that a fortress would be comparatively immune from damage if hostile vessels could be prevented from closing within 15,000 yards, it is now possible for accurate bombardment to be carried out (provided that means of observation exist) at ranges up to 40,000 yards or even more.

(ii) *The increased speed of ships.* This factor increases the probability of attack, by reason of the added facility afforded to the attacker for rapid concentration for a raid.

(iii) *The development of small craft.* The coastal motor boat, with its small size, high speed, and wonderful steering qualities, has introduced a new power to the close attack by torpedo of vessels lying in roadsteads or harbours. Owing to its small size, it will be exceedingly difficult to detect during the hours of darkness, and its high speed and quick steering will render it a peculiarly difficult target to engage with gun-fire. It is, however, very vulnerable, and a single hit from even the lightest gun will probably be sufficient to cripple it.

(iv) *The light-draught heavy gun carrier.* This type of vessel, known as a "Monitor", was primarily designed for operating in the shallow waters off the Belgian Coast. It is practically unarmoured and carries one gun (or two) of the largest size. Its rôle is bombardment of land targets where the small depth of water will not allow of the operations of larger craft. For this reason it is particularly invulnerable to submarines. It is not designed to fight against other warships, and consequently it can only operate during the absence of hostile vessels or when protected by units of its own fleet, but, for the same reason, it can use a type of projectile more suitable for engaging land targets than can the capital ship.

(v) *Artificial fog.* This development, given the required atmospheric conditions, is a very powerful adjunct to certain forms of attack, such as blocking, boom-smashing, or attack by light craft. It can also be employed where long-range bombardment is being carried out by indirect fire. It is, however, a weapon which may recoil on the head of its user, should a change of wind occur unexpectedly, and it also suffers from the disadvantage that it can only be used under suitable atmospheric conditions, so that it may not be available at the very time when it is most desired.

Developments in the Defence.

As regards the defence, developments have been few, owing to the rarity of attacks. They have been chiefly in the direction of improvements to existing means and methods, rather than in the introduction of innovations, and have mainly affected the ancillaries of coast defence, such as means of observation, range-finding, etc.

Developments of the air arm.

It is unnecessary to labour the point of the vast changes introduced, both for the attack and the defence, by the development of air-craft.

Where, formerly, we had to consider operations by sea and land only, we now have to make preparations for warfare in a third element. Our ideas, therefore, both of attack and defence must necessarily be largely revolutionized, and our methods will require adjustment, in order to meet the new conditions.

Air-machines, whether in attack or defence, have three main functions to perform, viz:—offensive action, reconnaissance, and observation of fire.

Let us examine these activities from the points of view of the attack and the defence separately.

(a) *Air-craft of the attack.* The first, and perhaps the most important, point to notice, is that one of the chief factors in successful attack is enormously strengthened by the advent of air-craft, i.e., the factor of *surprise.* Not only does the immense speed of aerial machines very greatly reduce the time occupied between the inception and delivery of an attack, but their small size and consequent ease of concealment renders the preparation of, and concentration for, attack immeasurably less easy of discovery by the scouts of the defence than in the case of assemblies of naval or military forces. Where, in the old days, we might expect some *days* notice of an impending attack, we shall now probably have only as many *hours.* This consideration, therefore, shows that one of the first requirements of the defence is—Instant readiness for action.

The objectives of an aerial offensive action will be, so far as coast fortresses are concerned, the same as those hitherto accepted as the objectives of naval attack, i.e., firstly, important works, buildings, docks, etc., lying within the defended perimeter, secondly, warships lying in harbours or roadsteads, and thirdly, the actual works of defence themselves. An aerial attack will be made both by bomb-dropping and fire from machine-guns. Owing to the speed at which it will be carried out, there can be no question for the defence of "holding off" the attacker pending the arrival of our aerial fleets, as in the case of bombardment by sea. If our fighting air squadrons are not actually on the spot, the attack will necessarily be finished before they can arrive.

The second function of the attackers aircraft will be reconnaissance, for the purpose of discovering the dispositions and activities of the defence. This function may be combined with offensive action as described above.

The third function, observation of fire, will necessarily be an adjunct of a naval bombardment, and, by its means, such bombardment will be possible at the most extreme ranges.

It must be observed that both these two last functions will necessitate the presence of the attackers machines over, or in the close vicinity of, the fortress for some considerable time, during which they will be liable to be themselves attacked by gun-fire and by the defender's air-craft. They will therefore certainly be accompanied by fighting machines, for their protection while carrying out their duties.

(b) *Air-craft of the Defence.* The main functions of the defender's machines may be stated in order of importance as follows:—

Reconnaissance—in order to give timely warning to the garrison of an impending attack by air, sea, or land.

Fighting—to destroy or drive off the attackers machines when approaching the fortress for either of the purposes mentioned above, and also for the protection of the machines engaged in—

Observation of Fire—to assist the artillery of the defence in dealing with an attack by naval forces.

Offensive action—the direct attack, by bombing, of hostile vessels.

CHAPTER V.

ATTACK AND DEFENCE.

As we have seen above, we must be prepared to deal with land attack, naval attack, and aerial attack, therefore our defences must consist of land defence, seaward defence, and aerial defence.

Land Defence.

It has always been accepted as an axiom that, as a general rule, the land defence of a coast fortress is the business of field forces whether located within the perimeter or operating against the attacker from without. In certain localities, however, no such protection may be available, and, in any case, it will be necessary to provide some means of defence from within, to guard against capture by a coup-de-main, before the field army can arrive on the scene. For this purpose every coast fortress must include in its garrison mobile troops of some description. The duties of this mobile force may be stated as:—

(a) The close defence of vulnerable points.
(b) To hinder a landing by the enemy, within, or near to, the fortress.
(c) To attack the enemy when disembarked.
(d) To hold the landward front in the case of isolated fortresses, or in the absence of a field army.
(e) To maintain order among the population within the fortress.

The main object of the land defences is to keep the enemy as far away as possible from the fortress. For this purpose, therefore, risks will have to be accepted, and great mobility and a high standard of training will be necessary. In certain isolated places, the guns of the

seaward defences are so sited as to be able to engage an enemy attacking from the land, but this is a subsidiary, and not their primary, rôle.

Seaward defence.

The defence of a fortress against attack from the sea has, in the past, consisted of—

(a) Extended defence, provided by the navy, and consisting of cruisers, destroyers, submarines, etc., whose object is to seek out and attack hostile vessels before their arrival within range of the guns of the fortress, and

(b) Local defence, consisting of guns and searchlights provided by the army, and booms, nets, and minefields provided by the navy.

It is important to notice that the Admiralty, though approving the principle of extended defence, and though willing to supply the means whenever possible, has always declined to allot mobile forces permanently for the defence of particular localities.. This attitude is indoubtedly reasonable, since the main object of our navy is to clear the sea of the enemy's fleets, and not merely to stave off his attacks whenever and wherever made.

As regards local defence, the chief point to consider is the coast defence gun. We have seen that the increased power of naval guns, combined with the development of the air arm, has made it possible for bombardment to be carried out at ranges hitherto undreamed of. At the same time we know that the chief deterrent to bombardment by capital ships is the fear that they, the important units of the enemy's main fleet, may be destroyed in carrying out what is only a subsidiary operation. And therefore we might assume that long-range bombardment on a large scale need not be anticipated. But here we must remember that the capital ship of to-day is the obsolete ship of tomorrow, though armed with the same gun and protected by the same armour. Hence we must be prepared for bombardment in the future from ships which have all the power of the present-day capital ship, but which, being then obsolescent, the enemy will be prepared to sacrifice. It will therefore, perhaps, be not unfair to lay down certain assumptions, e.g.

(i) That the enemy will not risk his (then) capital ships, if possible.

(ii) That he *will* risk his obsolescent ships and monitors, in direct proportion to the importance of the place he is attacking.

(iii) That 40,000 yards is a reasonable range at which we must be prepared to engage him.

(iv) That the guns which we employ must be capable of penetrating present-day deck armour at that range.

For these two latter purposes it is evident that our present heaviest coast defence gun is unsuitable. It must therefore be replaced by a more powerful gun, and it would appear that nothing less than the 12″ would answer the purpose, if, indeed, it is sufficient. Probably a 15″ gun will be required.

Similarly, since attack by cruisers or block-ships will be carried out by vessels of present-day protection, our medium armament will require to be strengthened, and for this we suggest the 9.2″ or 7.5″ gun, according to the importance of the port.

Our light gun, for defence against torpedo craft, is an important consideration. It will not be sufficient to *damage* a hostile vessel,—it is essential to *stop* her before she arrives at a position where she can do damage. For this purpose, our light armament should consist of 4.7″ to 6″ guns, with perhaps a light automatic gun, or heavy pom-pom, for dealing with craft such as coastal motor-boats.

This re-armament appears, at first sight, to be a formidable matter —but it is not, probably, so large as it seems. We are not proposing to provide against operations by large numbers of vessels, but against individual ships or small groups. Consequently, though we suggest increasing the *power* of our guns, we could probably reduce their *numbers*. Due consideration of the probability of attack at each port, followed by careful siting of the allotted armament, would probably enable us to provide the necessary deterrent against bombardment, and the necessary obstacle to success of other forms of attack.

Guns on railway mountings.

Many suggestions have been made, from time to time, that the most economical method of defending our coast would be the installation of heavy guns on railway mountings, running on railways which should be laid along the coast line. The argument in favour of this is that it would deny to the enemy many sea areas from which, at present, he can carry out long range bombardment unmolested by gun fire. There are, however, several arguments which can be advanced against this proposal, among the foremost of which is the loss of accuracy in gun fire which it would entail. We do not want only to frighten the enemy, but to damage him. And financial considerations demand that we should do this damage with the smallest possible amount of ammunition. In other words, every round should be a hit. Provided that we have a gun, powerful enough to reach an enemy vessel at any range within which it must approach in order to bombard, and sited in such a way that, with aeroplane observation, it can engage a target in any direction within that range, it appears that it would be unwise to sacrifice the advantages conferred on the gun by the possession of a fixed and stable mounting. It would seem that the protagonists of railway guns overlook the fact that coast fortresses are not designed to protect

the whole of our sea-shore, but are intended merely to protect important objectives lying within their perimeter.

Aerial Defence.

As on the sea, so in the air, will it be necessary to provide for extended, as well as local, defence. The former will, of course, be solely the function of the R. A. F. The latter will be the combined duty of the army, with guns and searchlights, and of the R. A. F., with fighting aeroplanes And here we arrive at a most important consideration. In local defence seaward, the part of the navy is restricted to what may be termed the passive defensive, i.e., defence by means of mines, booms, nets, and other obstructions to navigation. In local defence air-ward, however, it must be accepted that no such passive defence can be completely efficacious, and hence the part of the R. A. F., must be an active defensive. All recent developments seem to show that the R. A. F., is becoming more and more truly independent, and there may well be reason to fear that the Air Ministry may adopt as regards both extended and local defence, an attitude similar to that of the navy in regard to extended seaward defence. Such an attitude would, of course, be deplorable. For local defence against aerial attack, the defence commander must have, as the chief of his weapons, a definitely fixed number of aeroplanes, and these machines must not be susceptible to removal without his consent. They must be looked upon as a permanent portion of the armament of the fortress, of equal importance with the anti-aircraft gun, since it must be admitted that guns alone cannot at present compete completely with aircraft.

The main objects of the air defences will be to guard against:—

(a) Bombing attacks on ships or other important objectives within the fortress.
(b) Bombing attacks on the works of defence.
(c) Reconnoitering or observing aircraft.
(d) Torpedo dropping aircraft.

In order to carry out these attacks with accuracy the enemy aircraft will have to fly at a low altitude. It will be the object of the aircraft of the defence to endeavour to prevent this low flying, by attacking the enemy during his approach to the fortress, but, should he evade the defenders, it will be for the guns of the defence to deter him from close approach or destroy him when carrying it out. An efficient organisation of anti-aircraft guns will therefore be required. These guns should be of the nature of 4″ calibre, and should have an effective height of at least 20,000 feet.

There is very little doubt that many of the attacks will be made at night and consequently provision must be made for anti-aircraft searchlights, both of the "sentry beam" nature and fighting lights. These searchlights must be entirely distinct from those of the seaward

defence, though of course each will assist the other if not required for its own purpose during an attack.

CHAPTER VI.

CONCLUSION.

We have seen that the Coast Fortress of the future will be liable to attack by land, sea, and air, and that to meet these attacks we shall require military, naval, and aerial, defences. In the case of each form of attack, a combination of at least two of the means of defence will be required. Thus our first and greatest lesson is the need for the closest possible co-operation between the three fighting services.

We have seen that developments of the past few years have greatly enlarged the scale of attack which may be expected. Hence we see that the scale of defence must similarly be greatly extended.

In the remarks above, for reasons of space, little has been said about the progress of what may be termed the ancillaries of attack and defence, such as the various methods of detection and ranging, surface, sound, and sub-aqueous, the development of lethal and non-lethal gas, the methods of producing artificial fog, the use of anti-bomb nets, bomb-proof protection, camouflage, etc. These matters are all more or less in their infancy, but they are advancing with rapid strides, and we must not allow ourselves to fall behind other nations in these respects. Thus our third lesson is the need for continuous and pains-taking experiment and research.

Having learnt these lessons we must then apply them. It has been pointed out that all coast fortresses cannot be treated, for purposes of defence, on the same lines. The first thing to do is to determine the probable scale of attack. This, as we have seen, will depend upon the desirability of the objectives, the distance from the enemy bases, and political and natural consideratons. Having decided on the probable scale of attack, we can then calculate the necessary scale of defence. And when this has been done, the final step is, obviously, to carry it out. This is the ideal. Is it, however, practical? We think not. We have seen that to provide a full scale of defence under modern conditions will, in most cases, entail a considerable rearmament of existing fortresses, and we have to bear in mind that the present financial stringency precludes any expenditure which is not absolutely vital to our safety. Also we must recollect the two 10 year factors mentioned in chapter I, and their bearing on our problems. When looked upon from this aspect, it appears that it would be folly to expend a large amount of money at this juncture, on heavy rearmament of, or on full complements of personnel for, our coast fortresses. There are, however, certain fields of activity which must on no account be starved. We refer to experiment, research, training, and practice. The develop-

ment of methods of attack and means of attack, though perhaps retarded, will not stand still, and it is incumbent on us to ensure that means and methods of defence are developed in at least an equal degree.

From War experience we arrive at certain deductions, which, however, require modification in accordance with post-war conditions. What, then, may we anticipate as being the condition of our coast fortresses during the next ten years? Guns in a state of "care and maintenance", P. Fs. and other instruments dismantled or covered up, mine-fields un-laid, anti-aircraft defences non-existent, and, last but by no means least, personnel cut down to the minimum required as caretakers. This will certainly be the case during the next year or two, while financial conditions are so stringent. But it must not be allowed to continue indefinitely. So long as human nature remains what it is, so long will fighting be the ultimate method of settling differences. Peace Conferences may assemble, Leagues of Nations may record resolutions, and the international policeman may intervene between disputants, but, though these bodies may *dissuade* from or *forbid*, they cannot *prevent*, war.

The statement which forms the motto for this paper was never more true than it is to-day, although war-weariness has, perhaps, blinded us to the fact. We have, no doubt, to face a period of stagnation as regards our coast defences, until more money is available for their development. But we must, as soon as our finances allow, begin a progressive and comprehensive re-armament and re-organization on the lines described in these pages. And, during both the period of stagnation and the subsequent period of development, we must do our utmost, by experiment and research, to keep abreast of every scientific and mechanical advance, and we must establish that close co-operation between the Army, the Royal Navy, and the Royal Air Force, which alone can ensure the proper fulfillment of the rôle for which our coast fortresses are designed.

Training, owing to shortage of personnel, is almost impossible of achievement for the time being. We can at least, however, train as *instructors* the scanty personnel we possess, so that in the brighter days to come they may be able to teach the "new entry". And it seems desirable here to emphasize that it will not be sufficient to rely entirely on the Territorial Army for the artillery portion of our coast fortresses. Not only does the R. G. A., form an important reserve of very highly trained men for the field army, but, in the critical early days of a war, it will be essential to have our defences manned by personnel who will not require any "shaking-down" process as a prelude to efficiency.

Thus, the, the future which we deduce for our coast defences during the next ten years is:—

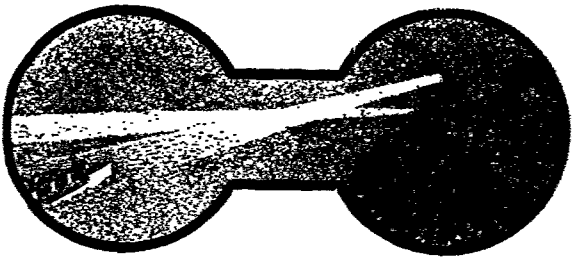
(a) A period of perhaps two or three years during which the whole of the money available for the fighting services will be devoted, and rightly so, to the organization and perfection of our means of offence, and the passive defence, as represented by coast fortresses, will remain "in statu quo". During this time no re-armament or other material development will be possible, and training will be practically nil.

(b) The period subsequent to (a), when the return of financial prosperity may enable us, not only to complete our preparations for the offensive, but also to devote funds to the development of the defensive. During this period, our defensive energies will be turned, in increasing intensity, to the development of our material and the training of our personnel, up to the standard which our war and post-war experience shows to be necessary.

(c) And, throughout the whole of both these periods, we shall be carrying on systematic and painstaking experiment and research, so that we may ensure for ourselves a position at least abreast of our possible rivals, should the peace of the world again be disturbed.

There is no doubt that the mere existence of the first, i.e., the stagnant, period will exercise a damping effect on the ardour of many an otherwise enthusiastic garrison gunner. But let us remember that, the lower we fall, the greater will be the honour when we have again raised coast defence to the eminence attained by it in the past. And the rapidity with which we can do this will depend on the extent to which we fit ourselves, during the stagnant period, to instruct those who follow us.

Experiment, research, co-operation, training. Let these be the watchwords of our coast defence orgainzation, and we may then look forward with confidence to a time when, with our defences re-armed in accordance with the demands of the two former, and our personnel prepared by the two latter, we may face any or all of our potential enemies, saying, in the words of the song—"We don't *want* to fight, but, by Jingo, if we do—"



EDITORIAL

Four Years Ago

ON the eleventh hour of the eleventh day of the eleventh month, four years ago, the last shot was fired. The sonorous bass in this fearful symphony was furnished for the American Army by the Coast Artillery—The Big Gun Corps. Now the poppies bloom and the fields are tilled, and as the scars of War are healed in northern France, so has the memory of the Coast Artillery's great effort been swept into the background by the arduous concerns of the months which have intervened.

Accordingly, it is especially fitting in this month of an Anniversary which affects the world, that the Coast Artillery should be reminded of its war-time effort in the sympathetic presentation in this JOURNAL by one of our best friends, Brigadier General Maitre of the French Army. In his resumé, General, then Colonel, Maitre gave to officers in his own army a fair and illuminating statement, and at the same time unintentionally performed for us a gracious service which we can not and would not forget.

As once again we are reminded of a Coast Artillery which was numbered by many brigades, regiments, and battalions, we are struck with a new sense of regret that now our organizations and men are so few; that the Coast Artillery has had to dwindle to the skeletonized cadre of its war-time establishment.

Our reflection on the apparent pettiness of our present estate brings before us in swift review the many other changes which have swept over the world and which sometimes have seemed to dim the bright light of personal friendship which many of us had learned to feel for our former comrades in the armies allied with us. By all means let the reminder of this Fourth Anniversary revive and refresh the friendship for the French and English comrades with whom and for whom we fought, reconsecrating a friendship which was welded in the furnace of a world in arms.

As each of us looks back four years, he can remember scores or hundreds of his own Coast Artillery comrades, soldiers and officers, who are now scattered to the four winds, many of them lost to acquaintance forever. Happy is he who can look back four years and feel the assurance that if these scattered comrades now remember him at all, then the memory is tinged with respect and warm good will. Wars are separated by a generation, and perhaps but few of us who were in our country's service four years ago will have occasion to participate in another war. But if we do, may every memory of the past and every act and decision of the present, mold in us the spirit which in another war will enable each one to achieve success for the Coast Artillery and a wholesome respect and genuine comradeship for ourselves.

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Grandmother, Baseball and Other Things

"My Grandmother," began the new office boy—

"O yes, I know the baseball season opens tomorrow and you want to get off to go to her funeral," snapped the boss.

"No sir," replied the boy, "I was going to say that my grandmother is a red-hot fan and wants me to go to the game with her."

All of which shows how times change. It is hardly safe nowadays to take too much for granted, even in the Army, when we used to believe that we had a definite position on the promotion list and certain retirement privileges awaiting us in our old age. So many changes have been made, and so many more are imminent that it might be in order to provide an open and closed season for the Army, just as they do on game preserves, otherwise we fear that this constant poaching will exterminate the species.

It is not to be denied that the constantly recurring element of uncertainty in the conditions surrounding our life and work tend to discouragement and lassitude.

"Uncertain ways unsafest are,
And doubt a greater mischief than despair."

Sir John Denham, away back in the seventeenth century, allunwittingly diagnosed in two lines the essence of the miasma which for at least six months is bound to distribute its poison through the atmosphere of the United States Army.

But in spite of these months when the Sword of Damocles sways impartially on its slender thread over the heads of all, the Army is not slowing up. In spite of gnawing doubt and anxious uncertainty the Army is going full speed ahead—in the training of the regular troops, and in a whole-hearted exploitation of the Government's policy of building a nucleus for a Citizen Army. On every hand National Guardsmen,

Reserve Officers and C. M. T. C. candidates are voicing an enthusiastic and universal appreciation for the earnest and helpful spirit of their regular Army instructors.

After the sorry business is over—then what? While it has been truly said,

"One minute may give invention to destroy;
What to rebuild, will a whole age employ,"

yet the survivors must not mark time. In the live wire phraseology of American life there have been coined two new words, "actomist" and "peptomist." Even the latest dictionary fails to define either of these words as a person who combines optimism with irrepressible "pep" and activity. If there is any calling in America today which demands a full quota of actomists and peptomists it is the Army. For it takes an actomist and a peptomist to have the courage to believe with old Pittacus that, "The greatest good is to do what you are doing at the moment well," and to accept the great precept, "Whatsoever thy hand findest to do, do it with thy might."

After the decimation of our ranks is over the survivors must close in, fill the gaps, and in the face of depleted resources and diminished means, must carry on and rebuild the military structure which must none-the-less bulwark the State in its unlooked for hour.

COAST ARTILLERY BOARD NOTES

Work of Board for Month of September, 1922

1. Personnel of the Board on October 1, 1922:

Colonel H. J. Hatch, C. A. C., President (sick in hospital).
Major W. B. Hardigg, Ord. Dept.
Captain G. W. Morris, Signal Corps.
Captain L. W. Jefferson, C. A. C., Secretary.
1st Lieut. J. J. Johnson, C. A. C., Computer.

2. Attached:

Lt. Colonel H. L. Butler, C. A. C., Acting President.
Major J. S. Pratt, C. A. C., For Training Regulations.
Major H. F. Spurgin, C. A. C.
Major R. B. Colton, C. A. C.
Major E. C. Kelton, C. of E.
Captain A. Bradshaw, Jr., C. A. C., Anti-Aircraft Projects only.

3. The preparation of, and consideration of Training Regulations occupied a considerable portion of the Board's time during September. The status of these regulations is substantially as given in last month's issue of the JOURNAL. Work was confined mostly to "The Battery Command," pamphlet which is nearing completion. Extended conferences were held on this document as drafted and the battery commanders at Fort Monroe were called in consultation. The drill of the fire control section will be tested out at Battery Parrott (12-inch guns) and at Battery Anderson (mortars). Suggestions relative to the preparation of, and material to be incorporated in, this important pamphlet, coming from officers throughout the service will be given careful consideration by the Board. The new pamphlet contemplates several important future changes in the Coast Artillery Drill Regulations and current instruction orders, especially in the matter of adjustment of fire at moving targets.

4. New Projects received during September:

A. Rectangular coordinates slide rule—Project No. 66. Received September 8, 1922. Designed by Master Sergeant William J. Helmer, of the Subaqueous Sound Ranging Section, Fort H. G. Wright, N. Y. This slide rule is designed to convert the azimuths of a given target or point from two base end stations into grid coordinates. The slide rule will receive consideration by the Board during the month of October.

B. A spotting chart designed by Colonel H. J. Hatch, C. A. C. has been given Project No. 67.

C. Major Paul D. Bunker, C. A. C. is the author of a manuscript submitted to the COAST ARTILLERY JOURNAL on the subject of standardizing the examinations for Expert Gunner (Rated Positions). The idea is advanced that the COAST ARTILLERY JOURNAL should publish an instruction pamphlet for use by candidates

for Expert Gunner (Rated Positions) similar to the Instruction pamphlet in use at present for 1st and 2nd class gunners. The examination then to be based on questions and practical demonstrations as set forth in this pamphlet and a definite weight or mark to be assigned to each subject. The matter was referred to the Board and given Project No. 68. In this connection the Board considered, and recommended certain changes to be made in Training Regulations No. 435-310 (Examination for Gunners, C. A. C.). The Board approved in general of Major Bunker's scheme, a detailed account of which will appear later if finally adopted. The Board recommended:

(a) That the various gunner's pamphlets be revised under the supervision of the COAST ARTILLERY JOURNAL so as to embody therein questions and answers covering the subject of expert gunner.

(b) That the Gunner's Instruction Manual lay stress on the necessity for practical as well as theoretical knowledge. It should be required that in order to successfully pass an examination for expert gunner a candidate should demonstrate practically his ability to perform the duties of the position upon which he is being examined.

(c) That the following pamphlets be published:
For Gun Companies.
For Mortar Companies.
For Mine Companies.
For Gun Battery, anti-aircraft.
For Searchlight Battery, anti-aircraft.
For Machine Gun Batteries, anti-aircraft.
For Headquarters Detachment and Combat Train, anti-aircraft.
For Railway Artillery Batteries.
For Tractor Artillery Batteries.
For Sound Ranging Companies.
For Trench Mortar Batteries.

(d) That the publication of the above pamphlets be not undertaken until the revision of training regulations has been accomplished.

D. A review of the second report in connection with service test of Caterpillar adapters for 155 m/m gun, Model 1916 (Filloux) and 8-inch Howitzer, Mark VIII—½. Assigned Project No. 69. The test was made by the 51st Artillery C. A. C. at Camp Eustis, Virginia, during June and August 1922. The Coast Artillery Board reviewed the report and concurred in the recommendations of the Tractor Artillery Board at Camp Eustis under whose supervision the test was conducted. A description of the test and a statement of results arrived at and recommendations made will appear under separate heading in the JOURNAL.

E. The "Tatelec" Waterproofing Process, Assigned Project No. 70.

(a) Articles of clothing now being manufactured for service test from cloth treated by the "Tatelec" waterproofing process. This process consists of the electrolytic infusion of a water repellant chemical in the individual fibers of the cloth without closing the pores or interstices between the fibers. It is, therefore, claimed that a waterproof, porous garment is being produced which can be worn, without the excessive warmth, lack of ventilation and discomfort incident to rubberized or non-porous waterproof clothing.

(b) Twenty treated and twenty untreated of each of the following articles will be shipped by the Quartermaster General for service test by the Infantry, Cavalry, Field Artillery and Coast Artillery Boards, and the Commanding officers of the Seventh Corps Area andthe Panama Canal Department, exceptt hat breeches, coats and overcoats will not be sent to Panama.:

Breeches, woolen, o.d.

Coats, woolen, o.d.
Overcoats, woolen, o.d.
Leggins, spiral
Shirts, flannel
Blankets, woolen, o.d.
Tents, shelter
Hats, service (if it is possible to treat hats by this method).

(c) Upon receipt of this material, test will be conducted by the Coast Artillery Board to determine in a practical manner the possible superiority of the treated to the untreated cloth with reference to waterproof qualities, appearance, durability, comfort and general suitability, for military purposes.

(d) A final report with recommendations will be forwarded when test is completed.

The uniforms to be tested had not been received by the Board on October 5, 1922.

5. Projects previously submitted on which work has been accomplished:

A. Spotting Boards. Lt. Col. J. C. Ohnstad, C. A. C. has been actively engaged in supervising the construction of, and installation of, the Bowler Spotting Board, Project No. 17; the Hall-Ellis Spotting Device, Project No. 60; the Thompson Spotting Chart, Project No. 39; the Wells Spotting Chart, Project No. 64; the Hatch Spotting Chart, Project No. 67, and the Gray Spotting Device.

In addition to the above, Lt. Col. Ohnstad is having constructed a spotting device of his own design. Lt. Col. Ohnstad is doing the work on spotting devices in preparation for the joint Coast Artillery and Air Service exercises to be held at Fort Monroe this fall. During the firing at that time all of these devices will be given a thorough comparative test and the merits of each will be determined under as nearly actual service conditions as possible.

B. The test of self contained range finders, Project No. 47 has continued in progress. Observers are being trained and readings taken daily. Results are being carefully tabulated with a view to determining the relative merits of the various instruments while observing is done on stationary and moving terrestrial objects and aircraft under varying conditions of atmosphere and light.

C. A program has been drawn for the test of Tangent Reticule Instruments Project No. 11, for high burst ranging which will involve firing mobile artillery at Camp Eustis.

D. The comparative test of T. I. Bells type mc-8 and mc-10, Project No. 38, continues in progress in the Coast Defenses of Chesapeake Bay.

E. Anti-aircraft mounts for caliber .30 automatic arms, Project No. 50. Program drawn and tentative date set for firing tests which probably will be completed by October 15, 1922.

F. T. I. Apparatus for Mobile Artillery Units, Project No. 56, transferred to Camp Eustis for test.

G. Radio Direction Finders, Project No. 62.

The Artillery Board has recently received from the Signal Corps two Radio-Direction finder equipments for an extended test. These sets are the result of a considerable amount of development and experimental work along radio lines. They will be tried out during the joint Coast Artillery and Air Service exercises to be held at Fort Monroe this fall.

Employment of Heavy Artillery—Problem No. 4—A Solution

1st Requirement:

Major A, after asking any questions at Hq 301st F. A. Brig. about points which may seem to him doubtful, asks for by phone and obtains the assistance of a camouflage expert from Hq 3d Corps, who accompanies him on his reconnaissance.

He returns to NEW OXFORD and sends his Intelligence Officer to visit headquarters 3d Corps MT. PLEASANT S.H. and all division and artillery brigade headquarters in 3d Corps, in order to get in touch with the local situation. He then directs his Plans and Training Officer to acquaint the battery officers with the situation.

He assembles the two battery commanders, the orienteur, and communications officer, the master gunner, observer corporal, an orderly, and an observer sergeant from each battery, with transportation consisting of:

1-Touring Car.
1-Reconnaissance Car.
2-Motorcycles.

After scrutinizing the map, he proceeds to CR 520 (near BRUSH RUN) where he leaves his transportation, examines the siding NE of BRUSH RUN, and proceeds along the railroad to the west with his parties (less chauffeurs). The transportation is directed to meet him at RJ 552. 360.3-754.0. Tentative battery positions are selected (see 2nd Requirement) and tentative plans made for their camouflage in consultation with the battery commanders and the camouflage expert. Houses and barns along the railway track are examined for possible battery CP's and batter commanders make tentative selections thereof. Arriving at RJ 552, Maj. A announces that the battery positions and battery CP's tentatively selected will govern. He directs the orienteur to run an orienting line and to determine the coordinates of the individual mortar positions at once and to check his orientation data by astronomical observations before midnight.

He consults with his battery commanders and the camouflage expert and comes to a definite decision as to the additional camouflage material that will be drawn and as to the point and hour at which it will be drawn. He informs the battery commanders that the battalion supply officer will be directed to draw this camouflage material and deliver it to the battery positions by truck by 9:00 PM. He sends the following message to the battalion supply officer at NEW OXFORD:

"Draw (such and such, material) at Camouflage Dump at SELLS STATION at 5:00 PM, and deliver it by truck to battery positions which are indicated on map herewith, prior to 9:00 PM this date."

He sends the camouflage expert back to Hq 3rd Corps in one of the motorcycles and gives the motorcyclist the above message to the battalion supply officer. He rejoins his transportation and examines the houses between RJ 552 and CR 520 for a location for his CP, and locates it at the point shown in the solution of the second requirement.

With the reconnaissance car and touring car, the communications officer, the two battery commanders, observer corporal, and one observer sergeant per battery, he goes forward to GULDENS. Here he leaves the transportation, directing the motor car to proceed to MT. VERNON SH (357.0-748.2) and there await him.

Accompanied by his party on foot, he goes to GRANITE HILL where he selects his OP. He directs observer corporal to make duplicate panoramic sketches of field of view of OP and then to return to GULDENS where reconnaissance car will return him to camp.

Maj. A with remainder of his party proceeds south along the ridge to pick out battery OP's. When these are selected and marked, he proceeds to MT. VERNON SH where he takes his car and returns to NEW OXFORD, on the way back locating the Aid Station at 362.3-754.3. He makes a sketch showing location of CP's, guns, and OP's. He forwards it, with one copy of panoramic sketch of field of view of his OP to C. O., 301st F. A. Brigade.

Each battery commander has an observer sergeant at his OP make a similar sketch for his report.

He obtains the use of a locomotive from the RTO at NEW OXFORD to haul up his guns that night. He uses his switch engine to make up the firing battery trains for each battery in the desired arrangement (head to rear) as follows:

Store Car
Mortar
Ammunition Car
Mortar
Ammunition Car
Mortar
Ammunition Car
Mortar
Ammunition Car
Store Car
Locomotive

Major A directs that as soon as it is dark, the firing battery trains of Battery A and Battery B shall successively be pushed to their positions, spotting each mortar and its ammunition car at its assigned position, after which the 16 remaining ammunition cars are to be taken to the cut at 365-755, the switch engine to remain *west* of these cars.

Meanwhile he directs the btry commanders to send up all their details except those for the Rear Echelon, using the motor transportation so far as possible, and begin the organization of the positions, CP's and OP's.

Rear Echelon to remain on siding just west of NEW OXFORD.

Communications to be established:

By Bn Communications Officer: Bn Radio Station.
Wire lines Bn CP to Bn OP, Bn OP to Btry A OP, Bn CP to Forward Communication center at NEW OXFORD (2 Pairs), BN CP to Radio Station, Bn CP to Aid Station.

By Btry A: Wire lines Btry CP to Bn CP, Btry CP to Btry OP, Btry OP to Btry B OP, Btry CP to Btry Exec., Btry Exec. to each mortar.

By Btry B: Wire lines Btry CP to Bn CP, Btry CP to Btry OP.

By Rear Echelon: Wire line to Forward Communication Center at NEW OXFORD.

Reasons for selection of positions. It was easy for Major A to see that within the area allotted to him, the trackage afforded possible battery positions only on the siding NE of BRUSH RUN, in the cuts west of BRUSH RUN, in the woods 1600 to 2000 yds. east of GULDENS, and on the siding at GULDENS. The last named position was immediately ruled out on account of its proximity to the front line, its total lack of concealment, and the fact that it was enfiladed. This meant that only one battery could be accommodated on a siding (at BRUSH RUN,) and that at least until firing spurs could be constructed, one battery would have to go in on the main line. Although the siding at BRUSH RUN is lacking in concealment, Major A decided to use it, so as to enable ammunition cars to be moved past one battery to replenish the supply of the other. Of the two positions remaining to be considered, an examination of the ground showed that there was but little choice from the standpoint of concealment, and so the position just west of BRUSH RUN was selected for Btry A, in order to facilitate control and communications.

The Btry camps and kitchens were spotted, Btry A at about 361.2-753.8, in the woods just east of SWIFT RUN, Btry B in the orchard NW of CR 584, orders being given that all movements between camps and positions should be restricted to the roads and RR.

The Aid Station as located, is readily accessible to both battery positions, is near a running stream and a road, is under cover of trees, and is afforded reasonable defilade.

All three of the CP's, as located, have the disadvantage of being at crossroads, and thus liable to suffer from interdiction fire, but this disadvantage is assumed in order to facilitate control and communications.

All three OP's are much exposed, but this condition can hardly be avoided if satisfactory forward observation is to be obtained.

Wire lines are laid so as to parallel roads as far as possible, both to facilitate laying and upkeep. Where they cross roads, they take advantage of culverts or are carried overhead. The mortars of Btry A are so separated as to require a line to each, through the Btry Executive.

The spotting of the extra ammunition cars is not satisfactory, as they block the main line between the battery positions and the rear echelon, but this circumstance is unavoidable in view of the prohibition against their remaining at NEW OXFORD.

2nd Requirement:

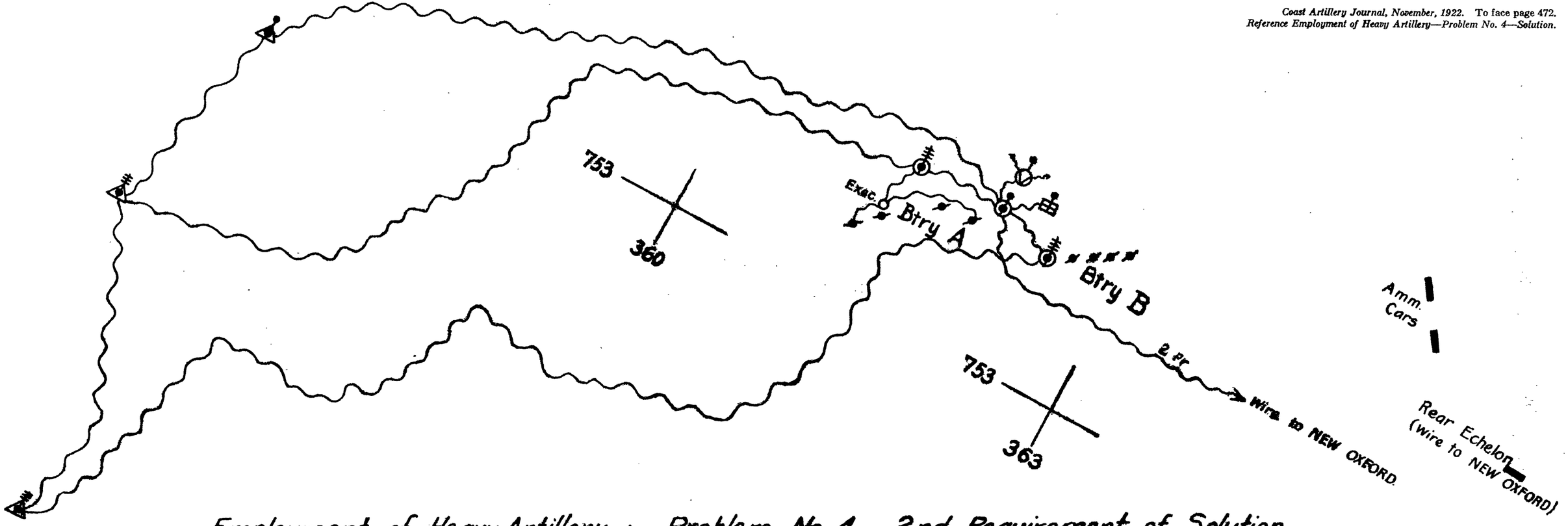
See sketch on insert herewith, to be placed over 3-inch map.

3rd Requirement:

Shallow dugouts are commenced in the sides of the railroad cuts at each gun position during first night. Where cuts are not available, trenches are dug to give cover for personnel. These dugouts and trenches are improved as time is available until in their ultimate development they become typical deep shelters. Men in forward echelon consist of command details, message centers, and gun crews (about 75 men per battery).

Officers and Hqrs personnel of battalion forward echelon are attached to batteries for rations. Rear Echelon messes with battalion hqrs mess.

The battery would be divided into following details:



Employment of Heavy Artillery – Problem No. 4 - 2nd Requirement of Solution.

1188

1. Ammunition and camouflage details (Btry CO) duties: prepare to set up nets. (Goes up by truck.)
2. Command Detail (1-Lieut) duties; organize CP and OP; goes by truck with party No. 3.
3. Wire detail (1-Lieut) duties; runs Btry lines. Goes up by truck.
4. Firing Battery (1-Lieut) goes up with mortars. Duties: emplace guns.
5. Rear Echelon (1-Lieut) remains in camp. Duties; Administration, training and supply.

The 1st group under personal supervision of Btry CO prepares to put the camouflage in place and digs out footings for floats.

When firing battery arrives the guns are spotted and floats broken out and dug in, the camouflage completed, the guns oriented, and the Btry prepared for firing.

As soon as the camouflage nets are in place and the guns are approaching readiness, the remaining men are set to work to provide shelter for firing crews.

Meanwhile details 2 and 3 have organized the CP and OP and run the wires indicated on diagram. As soon as it is light, Btry CO makes a careful inspection of camouflage and corrects any details that have escaped under cover of darkness. Tests out his communication system. Sends his details to breakfast.

Employment of Heavy Artillery—Problem No. 5

Maps: Gettysburg 3-inch, Bonneauville and Gettysburg Sheets, and 1-inch reduced from 12-inch War Game Map.

General Situation:

In continuation of Problems 1 and 3.

Special Situation (Blue):

The 1st Bn 701st Art has gone into position as indicated in Problem No. 3, on the nights of 26-27 and 27-28 March. At 9 AM 28 March the Bn Cmdr was summoned to Brig Hq where he was given the following instructions:

"An attempt to pierce the corps front is expected within the next 24 hours. The corps is to hold its position at all costs. Batteries are to be prepared for local defense, and two days of fire will be placed at each battery position. Your Bn will fire interdiction and harassing fire on the BALTIMORE TURNPIKE and the HANOVER ROAD. Any other missions will be indicated by special instructions."

1st Requirement:

Sketch to scale 12-inches equal 1 mile showing proposed field works for local defense of Btry B.

2nd Requirement:

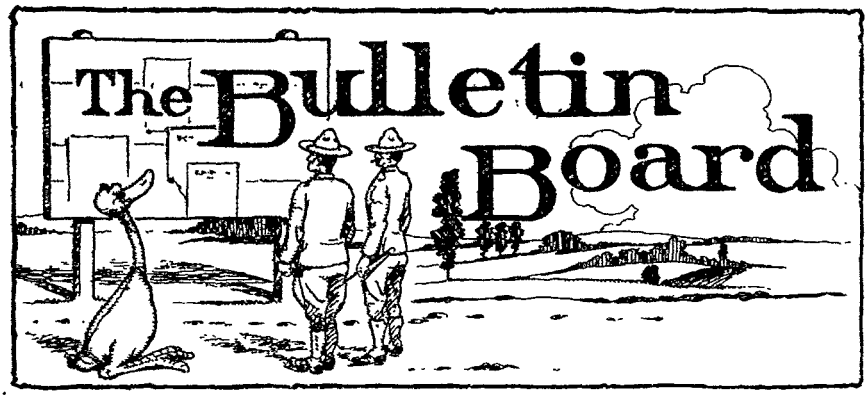
Points selected by Maj A to be interdicted with reasons therefor and estimate of ammunition to be expended on each.

At 4:00 AM 29 March, the hostile bombardment commenced. Maj A started his schedule of fire. At 6:00 AM the Bn OP of the 701st Art reported rocket signals from our infantry calling for a barrage thus indicating that the attack had started. At 8:00 AM all communications within and without the Bn ceased to function. At 8:30 AM a message was received from Capt E (Liaison Officer with 8th Div) as follows:

"Hostile reserves assembling in bed of WHITE RUN between RJ 452—CR 516 and BALTIMORE TURNPIKE. Div Cmdr asks for violent concentration on this area at once."

3rd Requirement:

Copy of all messages sent by Maj A after receipt of above message.



55th Artillery Continuing Moving Target Work with G. P. F.

Apropos of the development of the use of the G. P. F. in moving target work, a notice of which appeared in the October issue of the JOURNAL, a letter has been received from which the following is extracted, indicating that continued progress is being made.

"Recently we pulled off a very interesting target practice near Koko Head. We made a night march to a gun position just north of Koko Crater. From this position the batteries fired over the Koolau Ridge and used the typical C. A. C. horizontal base system with W. H. Plotting Board. The system as used was universal and readily transported in the light column. We used four gun volleys from the start, with terrestrial observation and the Cole Board for Spotting. A large number of volleys straddled the target. One battery fired four volleys for effect with one minute intervals. This may sound slow but the best that had been done before out here was with three minute interval.

"I think this practice cleared all doubt from the minds of those out here who were skeptical as to the value of the 155 mm. gun against moving naval targets. The target practice reports of this practice give in detail, with pictures of the improvised apparatus, a description of the system and the results obtained."

13th Coast Defense Command N. Y. National Guard Inaugurates Scheme of Civic Cooperation

On the evening of October 12, 1922, the entire 13th Coast Defense Command, New York National Guard, under command of Colonel Sydney Grant, tendered a review to Mayor John F. Hylan of New York City, in honor of the Knights of Columbus at the Brooklyn Armory of the 13th. The significant feature of the occasion was the fact that the program was arranged as a definite opportunity to make available to the Knights of Columbus the splendid Armory of the 13th. in pursuance of Colonel Grant's policy to enable civic organizations to congregate under the roof of the great Armory. Colonel Grant believes that as the people of the City and State pay their taxes for the maintenance of National Guard Armories, they should be able to derive a direct benefit from the use of these Armories other than that gained by the training of their sons in the National Guard.

Colonel Grant is to be congratulated on the far-seeing wisdom of this policy, which the JOURNAL is happy to recommend for the consideration of other Coast Artillery National Guard organizations.

At this Columbus Day Celebration over 10,000 Knights of Columbus and their friends witnessed the Review and the exhibition drills in Infantry and Coast Artillery work which followed it. Following the military program, thousands of the guests danced on the Armory floor to the music of the 13th Band, while about 200 of the guests repaired to the Officers' Squad Room where a collation was served, at the conclusion of which many speeches were heard and cheered.

The 13th Coast Defense Command has been officially commended at various times this year for its military work, by Major General John F. Ryan, Commanding the 27th Division, Colonel George A. Nugent, C. A. C., Lieut. Colonel Harry C. Barnes, C. A. C., Colonel Andrew Hero, Jr., C. A. C., and Colonel R. S. Abernethy, C. A. C.

BOOK REVIEWS

The Peril of the Republic. By Daniel Chauncey Brewer. G. P. Putnam's Sons. New York. 1922. 5" x 7½". 354 pp. Cloth.

This book is an attempt to show that the United States is facing an early political revolution, by reason of the mass of unassimilated foreigners who have crowded to our shores, and who have brought here the political theories of discontent which were forced upon them in the oppressive environment of the Old World. Books of warning and prophecy are very much in order these days, McDougall's "Is America Safe for Democracy?", Brooks's "Labor's Challenge to the Social Order," Mrs. Sanger's "The Pivot of Civilization," Work's "What's Wrong with the World," and Doughty's "Socialism and the Average Man," to name only a few, all trumpet a danger note, and all hark back for at least one cause of fear—to our compact and undigested masses of immigrants.

The book now being examined handles the subject more from the basis of "Socialism and the Average Man," than from that of any of the other books mentioned, with two notable differences: Mr. Brewer is more directly tied to the Immigration Problem as a source of peril, while on the other hand he is more profoundly pessimistic—almost hopelessly so. Remedy he has none, while his pessimism is not wholly convincing, because not sufficiently confirmed by citation to facts which would support his gloomy position.

Joining in Public Discussion. By Alfred Dwight Sheffield. The George H. Doran Co. New York. 1922. 5¼" x 7¾". 170 pp. Price, $1.25.

It has been truly said that nowadays every book that is profoundly interesting must be in some degree technical. Professor Sheffield presents under the above title not only the art of public speaking but that of joining in public discussion. One of the striking features of this little book is that the author understands the art of saying much in little.

The book is divided into two sections. Section one, Qualifying Oneself to Contribute; section two, Making the Discussion-Group Cooperate. In Chapter One, instruction is given in "gaining control over voice and bearing" with suggestions for daily exercise; in Chapter Two, on "how to decide what to say," one of the author's aims is to show that "the most formidable speaker is the man who can state his opponent's position better than the opponent himself." Having shown

how to take part in a discussion, the next point considered is "What makes a speech successful," followed by Chapter Four on "Sticking to the point."

Having learned to display good generalship in argument, the author says: "You realize that a speech which argues on half a dozen points without clinching a single one, is simply delaying the real work of discussion." In Chapter Five, on "How fact and opinion count in argument," he shows how "to become a skillful critic of truth values in argument." In Chapter Six, on "Arguing from causes and consequences," the student is taught "how to deal with argument that makes special demands upon reasoning." In other words, "just what is done in explaining anything." The two remaining chapters of section one, are Chapter Seven, "How to avert the misleading of words," Chapter Eight, "How to express oneself tellingly."

The two chapters of section two are, Chapter Nine, "How to secure thought organization in committee," and Chapter Ten, "How to use parlimentary procedure."

This little volume is the first in the series, "The Worker's Bookshelf," and is designed for members of labor unions, conferences, forums, and other discussion groups. The author has produced a work that is not only brief, but clear, persuasive and convincing.

The Constitution of the United States. By Thomas James Norton. Little, Brown and Co. Boston. 1922. 5" x7½". 298 pp. Index and charts at back of book. Cloth. Price, $2.00

Mr. Norton's book is most timely, coming as it does, when the women of the country have been admitted to full rights of citizenship. The conscientiousness with which they accept the responsibilities of suffrage will be a spur to the men of the country to acquire a better knowledge of our governmental system as established by the Constitution of the United States. To both men and women this book will prove of inestimable value.

The author explains the various clauses simply and clearly; supplies the historic meaning, and refers to important cases which have been settled by application of the Constitution. Mr. Norton recommends that the index at the back of the book receive diligent study. The charts, also, will be found most interesting, noting, as they do, events in the history of the country which contributed to the shaping of the Constitution.

Asia at The Crossroads. By E. Alexander Powell. The Century Co. New York. 1922. 5½" x 8¼". 369 pp. 58 Il. Price, $3.00.

Among the mass of written opinions on Far Eastern affairs it is gratifying to find now and then a book such as Mr. Powell's. His is first hand information, complete and impartial.

The author divides his book into four parts, devoting a part each, to Japan, Korea, China and The Philippine Islands, and concluding with the report of the Wood-Forbes Mission on the Philippine situation, dated October 8, 1921, and the two treaties regarding China, approved at Washington, February 4, 1922.

He doesn't mince words in sketching the double-barrelled administration which rules Japan, where two distinct governments—one constitutional and above-board, the other unconstitutional and unseen—exist and function side by side. He endeavors to make clear that the constitutional government, were it free from outside influences, would be democratic in its tendencies and pacific in its policies, whereas the invisible government is autocratic, militaristic, aggressive, and reactionary. But he does not believe that the majority of fair-minded Americans

object to Japanese commerical expansion on the Asian main-land, so long as that expansion is legitimately conducted, and not by intrigue or force.

In Part III Mr. Powell characterizes the pillaging of China by a handful of predatory nations, as "one of the most shameful and depressing chapters in the history of our times." He sketches briefly the main currents of events in the recent history of China and outlines the things that she should do to become a respected and prosperous member of the family of nations.

The case he presents for the ten million little brown brothers of the Philippines is born of careful investigation and painstaking study. He maintains that the Filipinos are not a people, that most ethnologists disagree with the claim that they are a distinct political entity. There are forty-three ethnographic groups or tribes in the archipelago and eighty-seven distinct dialects are spoken, representing peoples which have come to the Philippines at various periods in successive waves of immigration. In the event of granting independence to the Filipinos and thus withdrawing our protection from the Moros, the author says: "For us to attempt to coerce the Moros into submission to Filipino rule would be as unjustifiable as for the British Government to coerce the people of Ulster into accepting the rule of the Dail Eireaan."

Manual of Athletic Requirements. By Lieutenant-Commander W. A. Richardson, U. S. N. George Banta Publishing Co. Menasha, Wisconsin. 5¾" x 9½". 573 pp. Cloth.

This book was primarily written as a text to be used in the instruction of midshipmen at the U. S. Naval Academy and for this reason, some of its terminology may confine its use to a rather small group of men. However there is no reason why this book should not become a guide to all athletic instructors in the country as it has been thoroughly and attractively prepared.

There are some twenty-five different forms of athletics described with the utmost clarity and yet with sufficient brevity. Plentiful illustrations and simple wording make this book an instructor in itself. Altogether it is a splendid addition to the athletic world and should be in the possession of every man who rejoices in a sound body.

The Blocking of Zeebrugge. By Captain Alfred F. B. Carpenter, V. C., R. N. Houghton Mifflin Co. New York. 1922. 6" x 8¾". 276 pp. 33 Ill. 8 maps and plans. Price, $3.50.

Captain Carpenter has dedicated his book to THE-MAN-IN-THE-STREET. After having lectured extensively on this subject throughout Great Britain and the United States, he decided that a written account of the exploit should be of value "towards preserving that spirit which rallied all classes of individuals in the British Empire, in the Allied Countries, and in the United States, to the common cause of upholding civilisation in the face of danger." The feeling was particularly strong in this case to assure that the blocking enterprise would not be allotted a false position in the contemporary histories of the late war. Consequently "the author has—addressed this book to the man-in-the-street and has endeavored to 'put him wise'".

"The book has been divided into two parts. Part I deals with the Situation, the Object, the General Plan for the attainment of the Object, the Preparatory Work involved, and the various occurrences up to the eve of the Attack. Part II describes the events which occurred during the operation itself, and includes some consideration of both the material and moral results of the enterprise and the lessons to be drawn therefrom." Though the blocking of Zeebrugge and of Ostende together formed the greater operation of which this was but a part, the author

discusses only the one of which he was an eye witness and in which he participated. It may be well to remind the reader that Captain Carpenter was in command of the Vindictive which he laid alongside the mole at Zeebrugge under heavy fire during this operation and later withdrew.

To quote from Admiral Sims' Appreciation which appears as a foreword, "The reader of this volume will at once be struck by the painstaking care with which it was necessary that each detail be worked out, and each unit assigned its particular task to be executed at a specified time and place. Also that the amount of detail was necessarily so great, and their dependence one upon another so vital to ultimate success, that the whole may be compared to a complicated mechanism so designed to meet peculiar conditions that the failure of any part—any unit or group—or a material change in any of the conditions, would have deranged essential elements of the plan and might have jeopardised the success of the expedition." The book is exceptionally well arranged and remarkably illustrated. Captain Carpenter is to be congratulated on his contribution to the authentic history of the late war.

Aeroplane Structural Design. By T. H. Jones and J. D. Frier. Isaac Pitman and Sons. New York. 1920. 5½" x 8½". 273 pages. Price, $6.00.

The recent glider and "sailplane" contests are bound to have a far-reaching effect on the problem of structural design of the aeroplane. For it was experiments with the glider that afforded much scientific data used by the Wright brothers in their tests. Their first experiments were with the glider, 1899—1903, and it was not until a distance of about 600 feet was reached that they installed an engine. Two years elapsed before their plane remained aloft for half an hour and was driven twenty-five miles.

After twenty years, the glider is receiving renewed attention. The record made in the recent Clermont-Ferrand competitions when a French aviator succeeded in remaining aloft for two minutes and fifty-one seconds, has since been broken in the tests at Wasserkuppe in the Rhon hills, where the German aviator Hentzen succeeded in remaining aloft two hours and ten seconds, at the end having glided a distance of about six miles.

Because of the renewed interest in the glider, added attention will be given such tests as this valuable work on aeroplane structural design, particularly when we consider the feat performed by Fokker in remaining aloft a matter of minutes with a passenger in a sailplane invented by himself.

Messrs. Jones and Frier have endeavored to give adequate attention to the structural strength of the aeroplane. In planning the book, they had in mind the needs of the designer and stress draughtsman. It is their experience that "draughtsmen generally have more or less hazy ideas and views regarding the loading of aeroplanes, and more generally the methods of estimation of the strength of aeroplanes under such loading. It is, therefore, with the idea of dispelling this gloom that the proposal to publish the following matter in as palatable a form as possible, originated. To the purely academical and mathematically inclined reader, much of the matter may be lacking in direct interest, but it is hoped that the designer or the draughtsman who is responsible for the strength calculations of aeroplanes from a practical design point of view may derive considerable benefit. Utility, simplicity, and clearness throughout have been consistently aimed at, and it is hoped that this end also has been attained."

This volume, which is one of Pitman's Specialists' Series, is replete with illustrations, tables and folding plates, as well as an index, and is withal a very valuable addition to the science of aeronautics.